



# MODERN PLASTICS



JANUARY 1956

**1955—PLASTICS SALES BREAK ALL RECORDS**

—Progress and Prospects—

Materials—Page 78

Engineering—Page 115

Applications—Page 97

Technical—Page 135

## 12 BENEFITS

*of*

# DUREZ

## PHENOLIC RESINS

*for hard and semi-hard stocks of*

## NITRILE RUBBER

1. Improve **MIXING** - the resin plasticizes and reduces nerve.
2. Carry more **LOADING** - due to its fluidity when hot.
3. Improve **MOLDING** - it becomes plastic and then hardens.
4. Speed up **VULCANIZING** - by its fast cure and vulcanizing effect.
5. Increase **HARDNESS** - it sets hard of itself.
6. Increase **STIFFNESS** - through its natural cured rigidity.
7. **REINFORCE** - with increased tensile strength.
8. Step up **WEAR** - it improves abrasive resistance.
9. Withstand higher **HEAT** - by its inherent heat resistance.
10. Add **CHEMICAL** resistance by its natural resistance to solvents and chemicals.
11. Produce **GLOSSY** finish - another inherent resin property.
12. Add **WATER** resistance - by its resistance to water and oxidation.

Important new areas of usefulness are open to hard and semi-hard nitrile rubber compounds when these contain Durez phenolic resins. We list 12 benefits conferred by these resins as reported by rubber producers . . . four in processing and eight enhanced properties available in end-products. You are invited to use our many years of experience with the thermosetting phenolics in investigating their value for your business.



Molded parts for many purposes give better service when compounded of nitrile rubber with Durez resin.

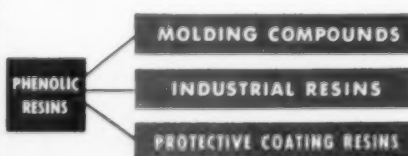
**YOURS FOR THE ASKING** - Our revised bulletin on resins in the rubber industry contains technical information that will help you assess these new procedures. Also free samples. Write today.

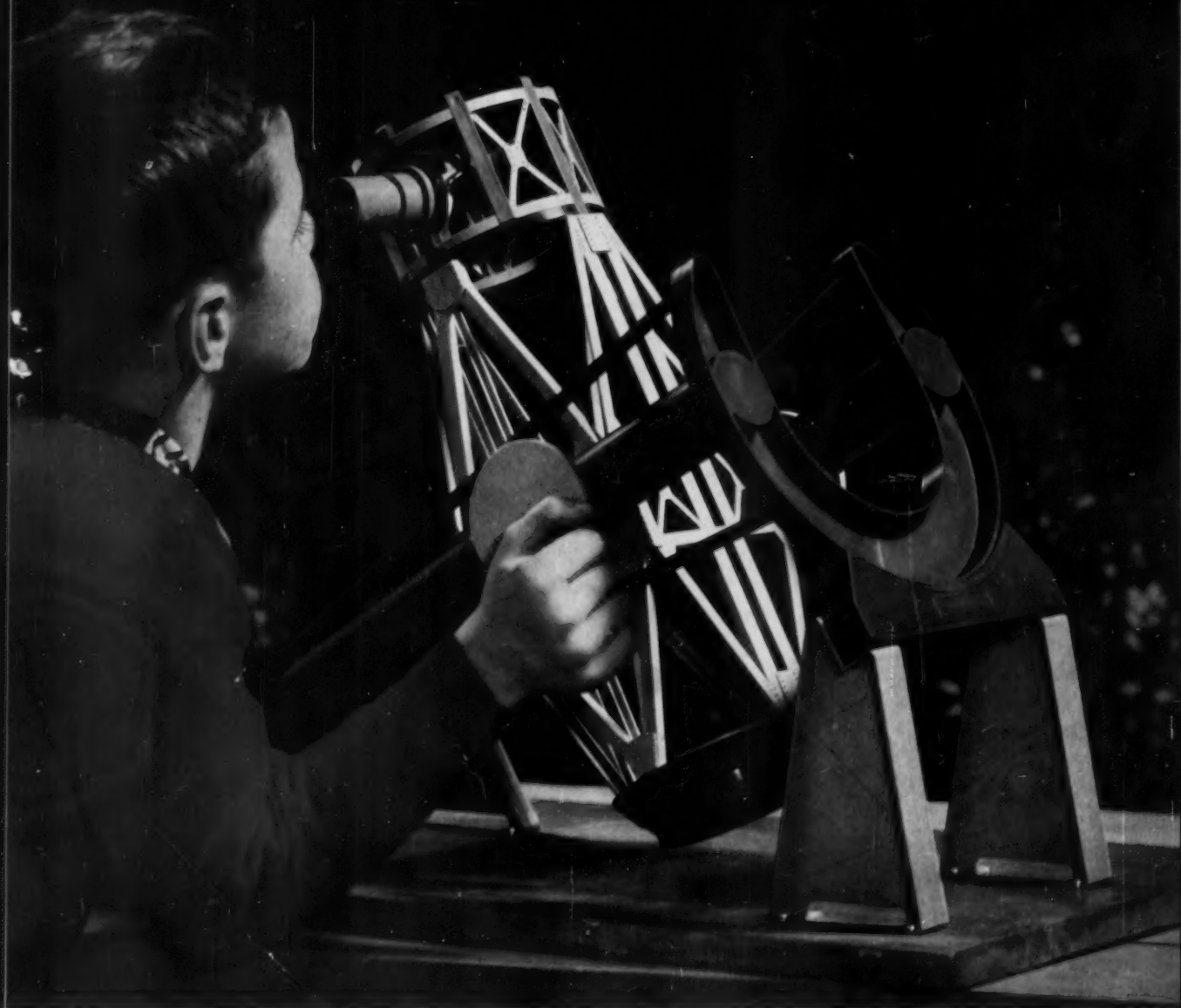
### DUREZ PLASTICS DIVISION

HCOKER ELECTROCHEMICAL COMPANY

1201 Walck Road, North Tonawanda, N. Y.

*"Leaders in  
phenolic plastics"*





*Is there, really, a Man in the Moon?*

"Mt. Palomar Telescope,"\* of **Catalin** HIGH IMPACT *Styrene* Peeks at the Planets

The famous Hale 200" Telescope atop California's Mt. Palomar inspired this working model. It weighs 2 lbs. and measures 21 inches long. One sixty-seventh the size of its illustrious original, this stargazer's delight is scale-proportioned from actual blueprints. To precision-mold the structure, the processing was entrusted to the one *model* material worthy of the instrument's careful planning... CATALIN High Impact STYRENE.

Accurately designed, perfectly balanced and portable, the cage is fitted with properly set reflecting mirror and focusing twin-lens eyepiece that enables young astronomers to study the Moon, Saturn, Jupiter and the heavens' many wondrous

constellations. Unit comes packaged, ready to use, or in easy-to-assemble kit form.

The uses for CATALIN STYRENE... medium, high and extra-high impact formulations... are broad—so broad that with this application as an example it might be said that *the sky is the limit!*

\* Molded by Fischer Plastics, Inc., Burbank, Calif.  
for St. Pierre & Patterson Mfg. Co., Burbank, Calif.

**CATALIN CORPORATION OF AMERICA**  
ONE PARK AVENUE • NEW YORK 16, N. Y.



In addition to Styrene and Polyethylene Molding and Extrusion Compounds, Catalin chemical products include a wide range of Urea, Phenolic, Crosslink, Resorcinol, Melamine and Styrene Resin formulations

# MODERN PLASTICS\*

January 1956 • Vol. 33, No. 5

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News of the Industry; Predictions and Inter-  
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Modern Plastics Executive and Editorial Offices: 575 Madison Ave., New York 22, N. Y.

Modern Plastics, published monthly by Breskin Publications, Inc., at Emmett St., Bristol, Conn. Modern Plastics Encyclopedia Issue published as second issue in September by Plastics Catalogue Corp., at Emmett St., Bristol, Conn. Second-class mail privileges authorized at Bristol, Conn. Modern Plastics copyright 1955 by Breskin Publications, Inc. All rights reserved. Nothing that appears in Modern Plastics may be reprinted wholly or in part without first securing special permission. Modern Plastics is regularly indexed in Industrial Arts Index and Industex. Subscription

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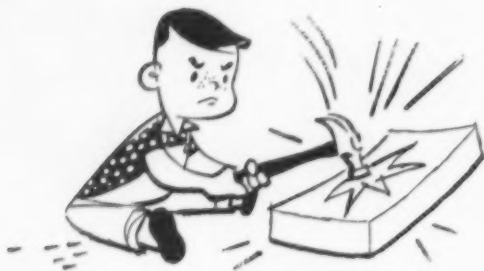
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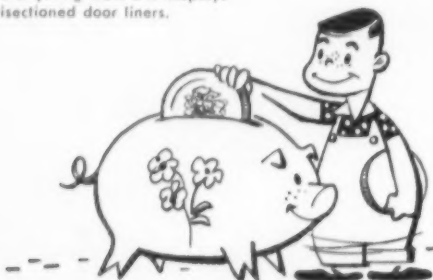


**Takes Any Shape** — if it can be made from sheet, you can do it with CAMPCO. It's easily, quickly formed into anything from 3-D displays to multisectioned door liners.

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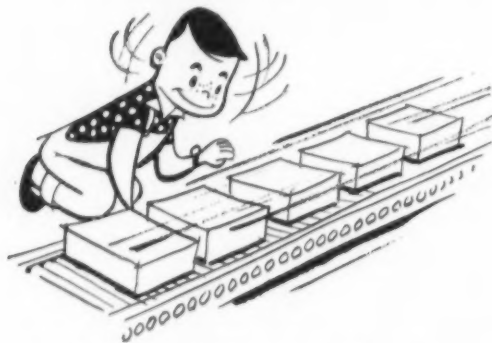


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January • 1956

# EDITORIAL

## Bigger Plastics Years to Come

The predictions of even the most enthusiastic analysts fell far short of the actual results of plastics' volume progress in 1955. A sales increase in materials of a billion pounds brought the industry's volume up over the 3½ billion-lb. mark.

Every plastic and synthetic resin shared in this tremendous advance. The full story is told beginning on page 75 of this issue.

Accompanying the 30% increase in sales of plastic materials was an increase in sales of processing machinery. Extrusion machine sales were up 25% over 1954. Injection machine sales were up 8 percent. Total thermoplastic sheet forming capacity increased by over 100 percent. And that story is told on page 133.

The interesting thing about this fabulous advance is that in 1955 the bases of plastics application were not broadened to the same extent as in previous years; the growth came mainly from a sound expansion toward bigger volume in already established markets. There were some outstanding application innovations during the year but these, too, were largely within the areas of markets in which plastics had already received some acceptance.

The combination of improved materials in greater variety, better design and engineering, more automatic equipment, higher quality tooling, establishment and acceptance of more standards, and more concentrated marketing gave this industry a bigger year than was expected—its biggest year to-date.

What now?

In view of the formidable increases in gross national product, in population, in disposable income, it is fairly obvious that the plastics industry has reached, not a plateau, but a new hill to climb.

Many economists predict that the 1956 gross national product will be up \$5 billion from its present rate of approximately \$400 billion. Most credit authorities consider our present consumer credit situation reasonably healthy in the face of present growth trends. But there are a few prophets who foresee fewer sales of automobiles, fewer home building starts, lower sales of home appliances, a softening of the soft goods market, and some increases in unemployment in 1956.

The great strength of the plastics industry in 1956, whether the year is one of continuing boom or merely one of general advance with slackening in specific fields, is that the plastics component factor in almost every product is constantly increasing.

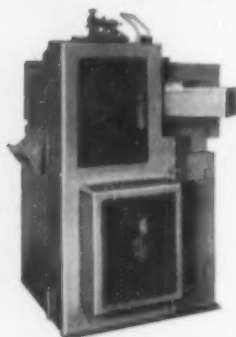
If fewer automobiles are made and each automobile made contains more plastics, the industry will gain. The same thing goes for home appliances, the building field, and many others. And that trend was firmly established in 1955 by the abovementioned combined efforts of all concerned. The pattern for future expansion of plastics has thus been established.

In addition, new and revolutionary concepts of design and production are now coming forth—concepts which are bound to increase the markets for plastics. Readers who may view the coming year with any trepidation whatever will find heartening facts in the application review on page 97. There is not now and never will be any limit to the future of plastics.

# CUMBERLAND

## Plastics Size-Reduction Machinery

### Cumberland "Stair-Step" Dicing Machines



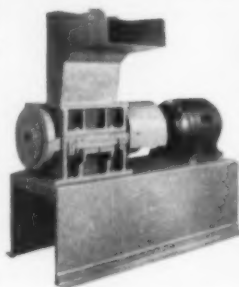
For dicing the full range of thermoplastic materials.

Cubes 1/16" to 1/2" produced from plastic sheet or ribbon stock. Pellet sizes altered merely by changing knives. Cubing is done in one severing operation with rotor knives cutting against one bed knife.

All surfaces contacting plastic materials are of corrosion-resistant metals.

Two sizes of machine available to handle sheets up to 7" and 14" in width.

### Cumberland Model 20 All Steel Granulator

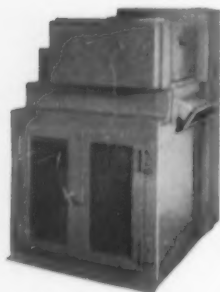


This heavy-duty all steel machine with 8" by 20" throat opening is suited for granulating tough plastic materials in the form of slabs, bleeder scrap, cylinder purgings, heavy cross-sectional parts, etc.

Frame and cutting chamber are of thick weldments with deep welds. Rotor and seal rings are heat treated and ground all over to provide tough, undamageable parts. Hardened surfaces preserve new appearance.

Machines resist wreckage. All inner surfaces are ground smooth to provide ease of cleaning.

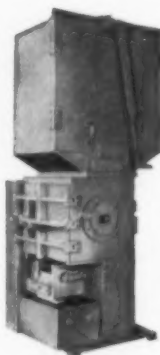
### Cumberland Pelletizing Machines



A versatile machine designed for use as a pelletizer, chopper or dicer. As a pelletizing machine: cuts multiple extruded strands of plastic material into cylindrically shaped pieces or cubes for use in molding or extrusion machines. As a notched knife dicing machine: handles principally vinyl sheet stock. A less expensive dicing machine although less universal than the Cumberland "Stair-Step" Dicer. As a chopping machine: efficiently cuts rubber and vinyl slabs into small pieces.

Available in two sizes to handle stock widths up to 14" or 24".

### Cumberland Pre-Breaker Granulators



Universal in its application, this dual rotor machine combines a pre-breaking machine and granulating machine in one compact unit. A large throat opening is provided to accommodate bulky reclaim as vacuum formed parts or trim. Also handles extra large and bulky parts and pieces of heavy cross-section as bleeder reclaim slabs, purgings, etc.

A special dome added to top of hopper makes machine ideal for long lengths of extruded pipe, rods, contours and similar items.

Unique hopper prevents any flyback.

Available in two sizes with 12" x 24" or 20" x 36" throat opening.

## GRANULATING MACHINES

### For Central Granulating and Use Beside the Injection Press

#### CUMBERLAND MODEL 0—V-Belt or Direct

Coupled (2 models)

For use beside each injection molding machine. Also for laboratory and miscellaneous uses.

Motor: 1½ or 2 h.p. Throat: 3¼" x 5½"

#### CUMBERLAND MODEL ½—V-Belt or Direct

Coupled (2 models)

For use beside each injection molding machine. Also for laboratory and miscellaneous uses.

Motor: 3 h.p. Throat: 4" x 8½"

#### CUMBERLAND MODEL 1½—Direct Coupled

For central granulating use.

Motor: 10 h.p. Throat: 5" x 12" or 8" x 11"

Write for our Bulletin 260

#### CUMBERLAND MODEL 10—V-Belt Drive

For use principally beside the injection press.

Motor: 3 or 5 h.p. Throat: 6" x 10"

#### CUMBERLAND MODEL 18—Direct Coupled

For central granulating use.

Motor: 20 h.p. Throat: 5" x 18" or 8" x 18"

#### CUMBERLAND MODEL 20—(illustrated above)

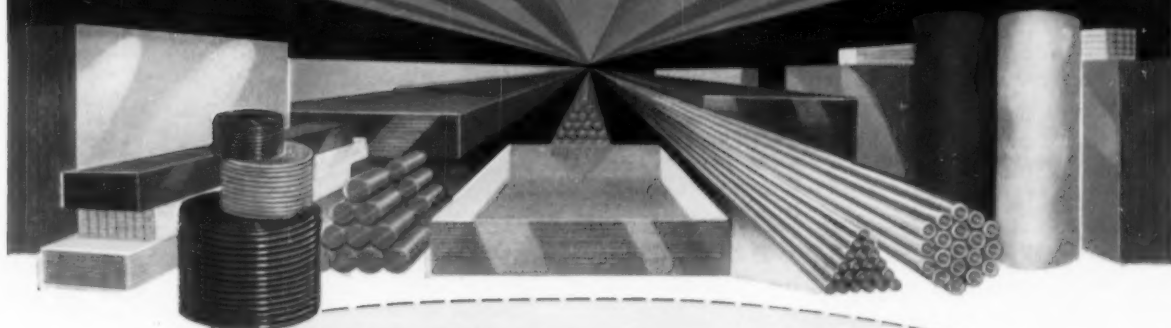
#### CUMBERLAND FINE GRANULATING MACHINE

A machine for granulating to a higher degree of fineness than is possible with conventional machines.

Motor: 25 h.p.



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# Do you get the most from your molding machines?

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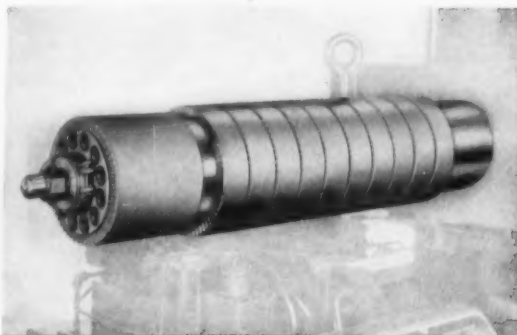
Do you know whether or not you're getting the maximum possible production on your products? Would you like to find out, at *no cost or obligation*, what your molds could produce? Reed-Prentice will give them a complete production test, on one of the newest "REED" injection molding machines.

Here's a chance to calculate accurately the increased production and lower costs you'd enjoy using the most advanced machines available today. The advantages of the "REEDS":

- Faster cycling time
- Lower pressures
- Lower temperatures
- Higher plasticizing capacity

are easily demonstrated under actual operating conditions.

At the completion of the tests, a detailed report will be submitted to you. All factors affecting the running of your molds are included. To get this information without cost, contact your nearest Reed-Prentice sales engineer. He will arrange for full production testing of your molds in our Test Department.



*For Faster Plasticizing—The NEW "REED-SPEED" Heater*

Only the "Reed-Speed" heating cylinder gives you:

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- Accurate "3-zone" temperature control
- New tapered spreader design, which creates a mulling action for more thorough plasticizing
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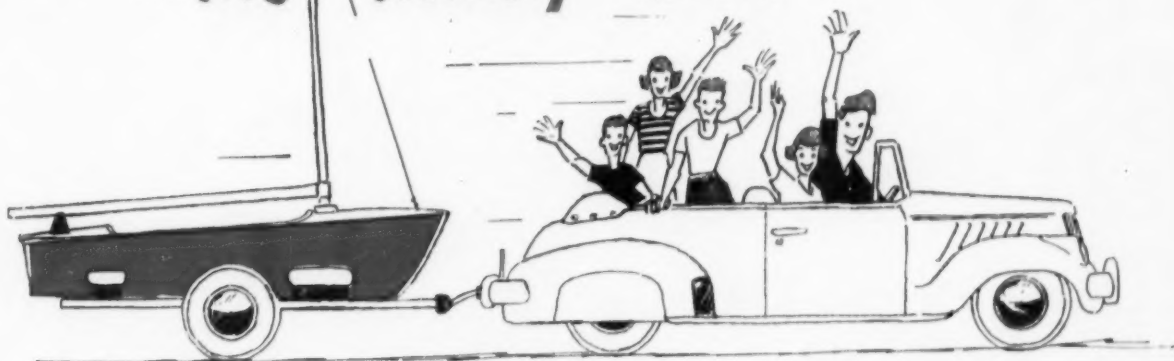
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Reinforced Plastics contribute to  
a new American phenomenon . . .

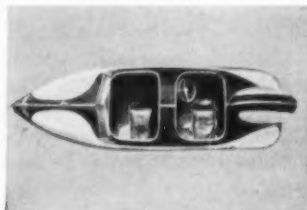
# the "family boat"



Sportster, 12 ft.  
Fleetcraft Inc.  
Palmyra, N. J.



Challenger, 14 ft.  
Lone Star Boat Mfg. Co.  
Grand Prairie, Tex.



Falls Flyer, 14 ft.  
Larson Boat Company  
Little Falls, Minn.



Sailboat (Moth), 11 ft.  
Challenger Marine  
North Miami, Fla.



Twin Motor Outboard, 18 ft.  
Marscat Plastics, Inc.  
New Bedford, Mass.



Sea Rocket, 14 ft.  
Whitehouse Reinforced Plastics  
Fort Worth, Texas

With 5½ million pleasure craft already in use private boating has become a billion dollar-a-year industry—and the forecast is for a 25% annual increase!

As boat sales mount by the millions, the "family boat" promises to become as commonplace as the "family car," washing machine, TV set and food freezer.

An important factor in the tremendous growth of the pleasure craft field has been the development of reinforced plastics. This structural material makes possible an attractive price, easily portable lightweight construction, low cost upkeep, and long service life. The way plastic boats stood up to the recent hurricanes proved to any doubter how amazingly tough and damage-resistant they are. With color molded in, they require no expensive care—no caulking, sanding, painting every Spring. They are not corroded by salt water. They're immune to the voracious teredo. Patch repairs can be made by an amateur.

Celanese experts in reinforced plastics have worked closely with the boat industry in proving the plastic boat. Marcothix\*, a thixotropic resin that stays put, showed the way to faster production of hand lay-up fabrication—giving more uniform hull thickness and even penetration. A wide selection of Celanese\* Marco\* Resins have been formulated to fit all methods of fabricating and molding.

If you are considering the design freedom, strength, and construction simplicity of reinforced plastics—for truck bodies, architectural panels, chemical tanks, or any other product—draw on the technical assistance of a pioneer in polyesters. Write for the latest facts on formulation and fabricating, to

Celanese Corporation of America, Plastics Division, Dept. 101-A, 290 Ferry Street, Newark 5, N. J. Canadian affiliate, Canadian Chemical Co., Limited, Montreal, Toronto and Vancouver.

46th ANNUAL NATIONAL MOTOR BOAT SHOW  
Kingsbridge Armory, N. Y. C., Jan. 13-22

**Celanese\*** plastics and resins  
\*Reg. U. S. Pat. Off.



**ALATHON®** can be molded into toys, such as this tea set, which are safe, attractive and practically indestructible.



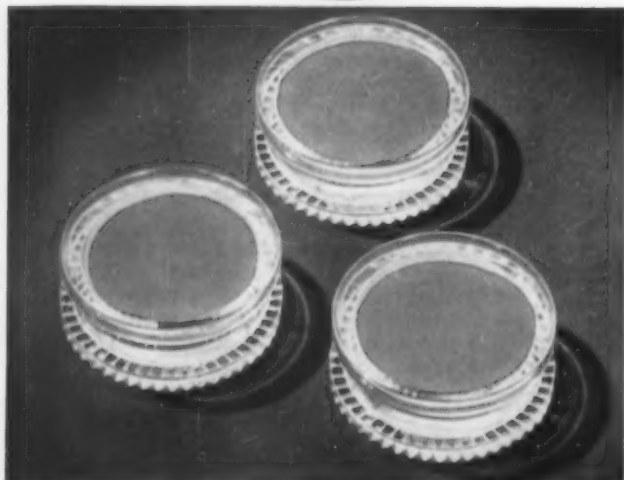
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## more examples

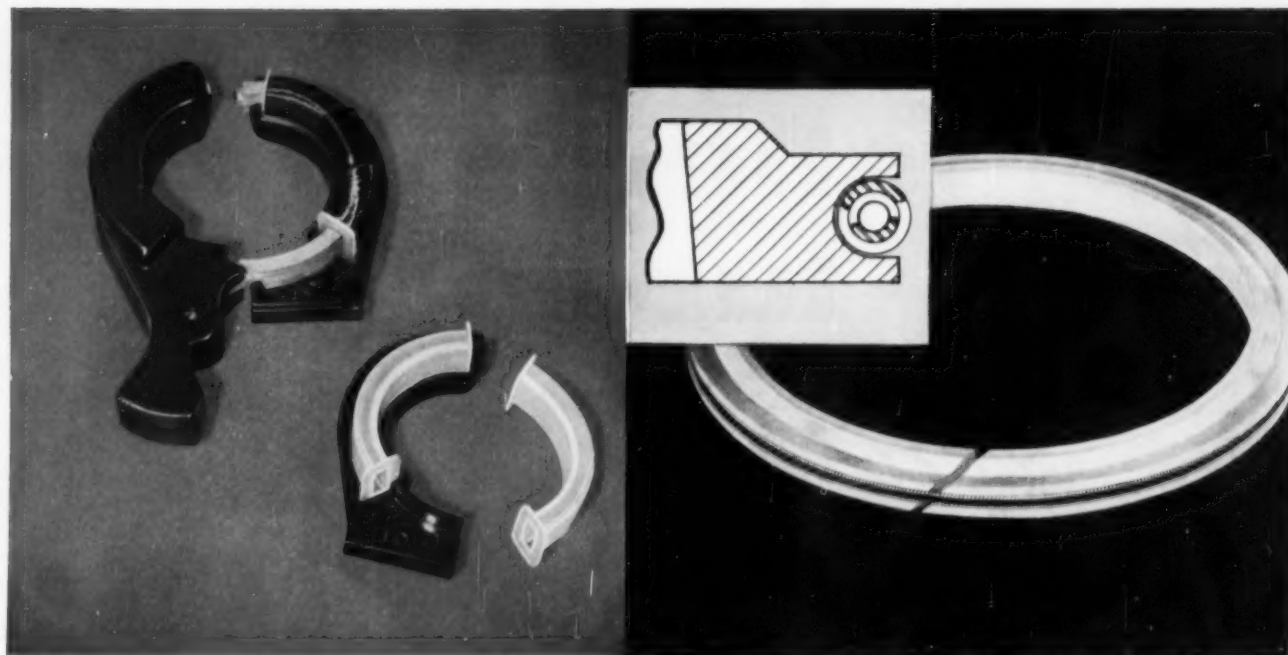
You probably will find, as others have, that you can give your product greater operating efficiency and longer life by making it of Du Pont "Alathon," "Lucite," "Teflon," or "Zytel." The applications shown here are typical of the product improvements possible when design and service requirements are evaluated in terms of the properties of these versatile engineering materials.

**"ALATHON"** polyethylene resin is being molded into toys that not only pack a load of "child appeal" but are practically indestructible as well. Du Pont "Alathon" is a logical material for making toys. It can be economically molded into complex shapes and is water- and shock-resistant. Tasteless, odorless and non-toxic, "Alathon" is strong even in thin sections. The possible applications for "Alathon" are many. It can be made into colorful and shatterproof housewares; extruded into film, pipe and wire jacketing; it is suited to packaging of many kinds. The electrical characteristics and high chemical resistance of "Alathon" recommend its use in industry. (Tea set molded by Ideal Toy Corp., Hollis, N. Y.)

**"LUCITE"** acrylic resin has sparkling transparency comparable to that of finest optical glass. Rouge containers molded from "Lucite" serve as an excellent point-of-purchase display and are pleasing to the touch. "Lucite" features high impact strength. When considering a material for lighting, signs or decorative purposes, you should



**LUCITE®** can give added sales appeal to a great variety of products. These transparent rouge containers make excellent merchandisers.



**ZYTEL®** makes possible compact designs, such as the coil forms for this G.E. hook-on volt-ammeter. It can be easily molded and has high dielectric strength.

**TEFLON®** is tough and chemically inert. When used as a scraper ring, "Teflon" keeps dirt away from vital O-ring seals in hydraulic equipment.

## of advanced product engineering

also think of "Lucite"; its applications are many and varied. (Molded by Augusta Plastics Co., Bronx, N. Y.)

**"ZYTEL"** nylon resin makes possible compact designs, such as the coil forms for this G.E. hook-on ammeter. This is because "Zytel" can be molded into complex shapes... retaining its strength even in thin sections. Another important advantage of Du Pont "Zytel" is that it can be injection molded at low cost per part. The mechanical strength, heat resistance and good insulating characteristics of "Zytel" recommend its use in both mechanical and electrical applications. (Molded by the Plastics Dept., General Electric Co., Pittsfield, Mass.)

**"TEFLON"** tetrafluoroethylene resin is inert to all chemicals except molten alkali metals and fluorine at elevated temperatures and pressures. It retains its toughness and flexibility at temperatures as low as -450°F., can give continuous service in many uses up to 500°F. The low coefficient of friction, toughness and chemical inertness of "Teflon" enable scraper rings in hydraulic systems to give long, trouble-free service. These qualities may help you. (By Shamban Engineering Co., Culver City, Cal.)

To get complete information on these engineering materials use coupon or write: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 301 Du Pont Building, Wilmington 98, Delaware.



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Please send me more information on the Du Pont engineering materials checked: ☐ "Zytel"® nylon resin; ☐ "Alathon"® polyethylene resin; ☐ "Lucite"® acrylic resin; ☐ "Teflon"® tetrafluoroethylene resin. I am interested in evaluating these materials for

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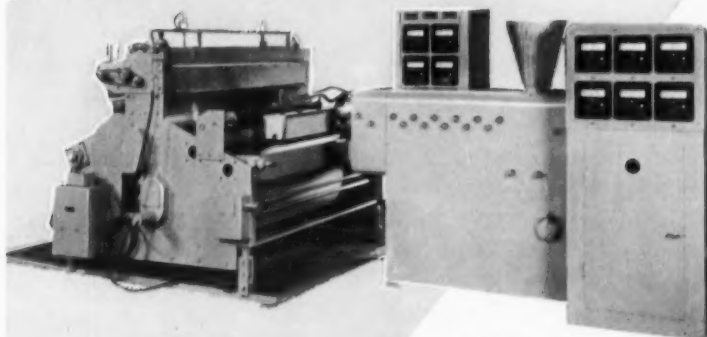
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Pictured at right is one of the early steps in the manufacture of *Cohyde*—a premium-quality, plastic coated fabric especially designed for use as a commercial, institutional and industrial wall covering.

This heavy-duty covering is made with a plastisol based on PLIOVIC AO—a vinyl copolymer resin. It is outstanding in its three-dimensional beauty and durability. It is designed to make the most of a momentum-gathering market.

PLIOVIC AO was selected for this application because it can be processed at relatively low temperatures. This not only makes for easier, more closely controlled production, but results in a more uniform product of better physical properties, by virtue of a shorter heat history being acquired.

Plastisols are economically compounded and processed with PLIOVIC AO, because it is an internally plasticized copolymer. This means its fine particles are more easily solvated than those of other resins, permitting use of a wider range of lower cost plasticizers and minimizing grinding. It also means the dispersion can be fused at as low as 280° F. for greater latitude in equipment and fabrics used.

If you plan on entering the "wall-plastic" field or on manufacturing any vinyl coated fabric, you'll find it to your advantage—processing- and product-wise—to know more about PLIOVIC AO. For details and the latest Tech Book Bulletin, write to:

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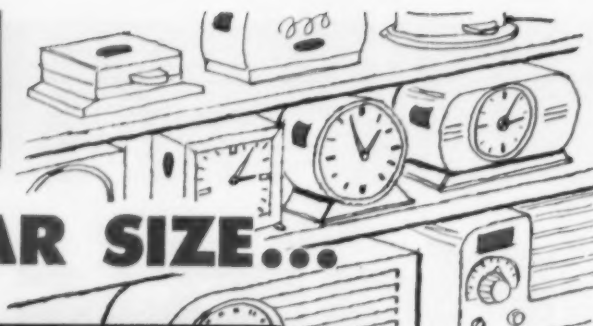
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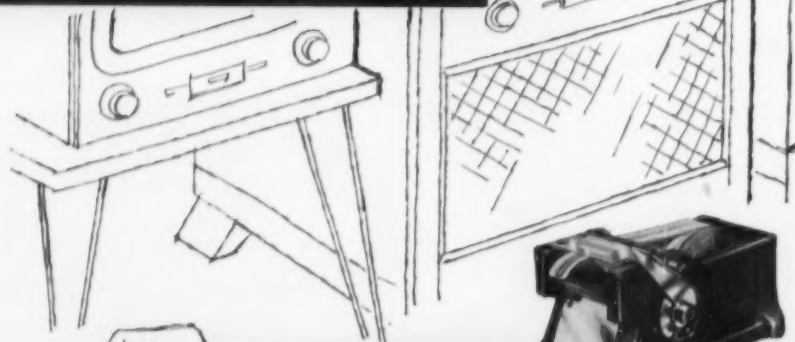
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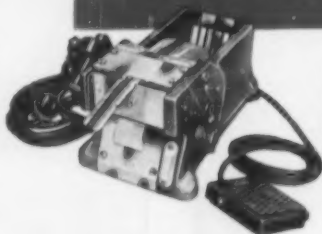
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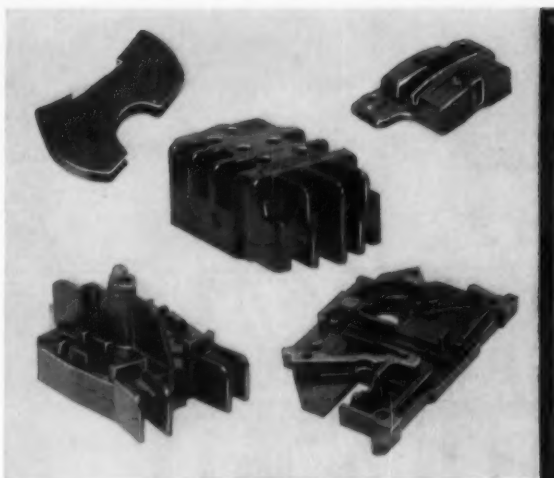
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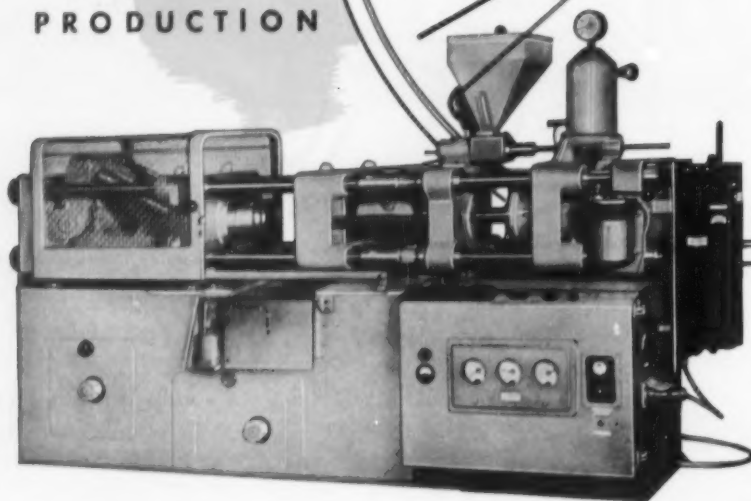
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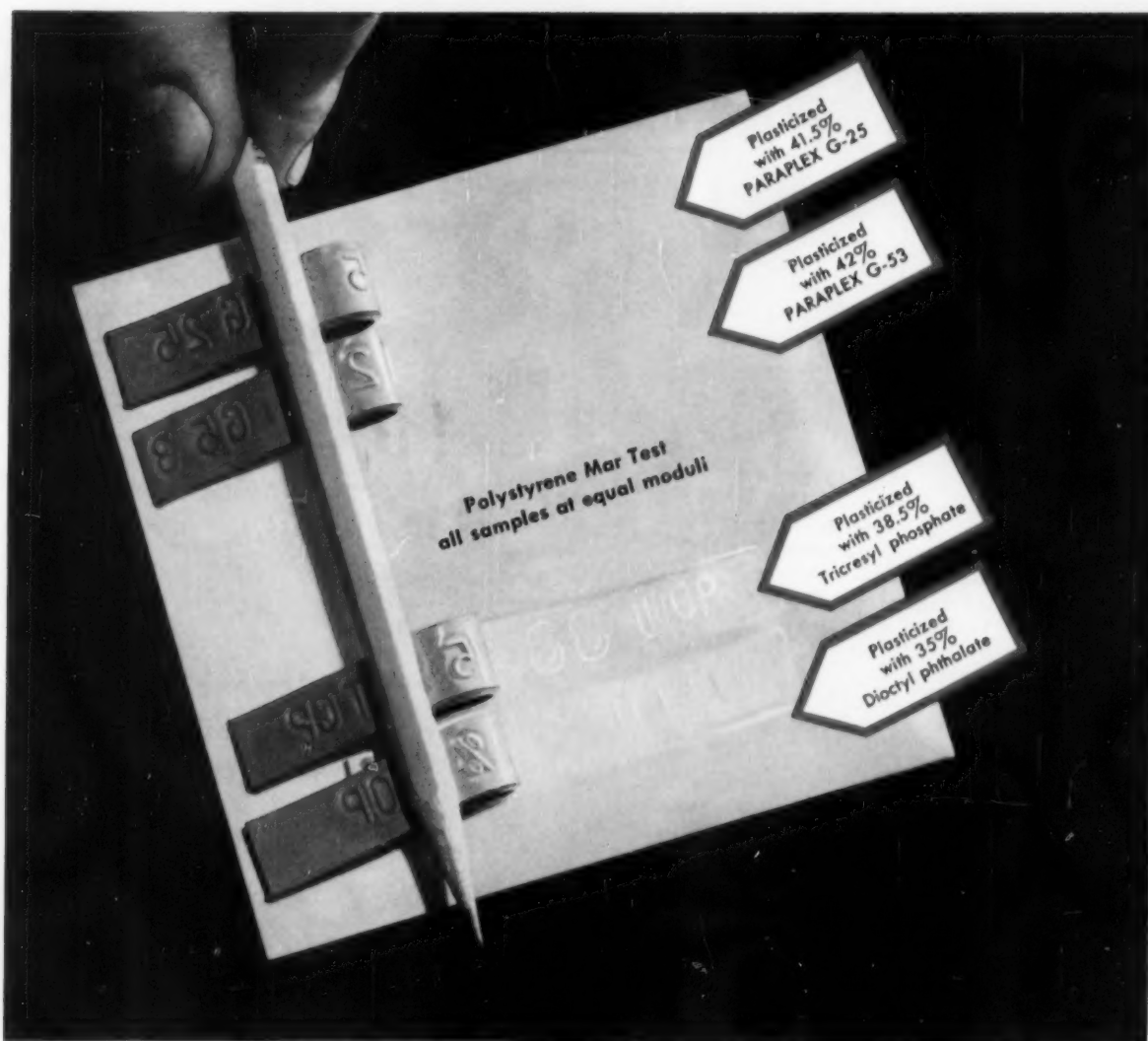
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Take polystyrene for example. Widely used in refrigerators and other appliances, polystyrene is often severely marred by vinyl gaskets containing so-called fugitive plasticizers. When PARAPLEX G-25 or PARAPLEX G-53 is used, migration is drastically reduced and

the appearance and physical properties of the polystyrene are virtually unaltered.

PARAPLEX plasticizers provide many other benefits, too. PARAPLEX G-53 is highly resistant to extraction by soaps, detergents, and hydrocarbons. It is extremely non-volatile. And its cost is quite moderate. High molecular-weight PARAPLEX G-25 has all of the physical properties of PARAPLEX G-53—and more.

For more information on *all* of the plasticizers produced by Rohm & Haas Company, ask for *What You Should Know About PARAPLEX and MONOPLEX Plasticizers*.

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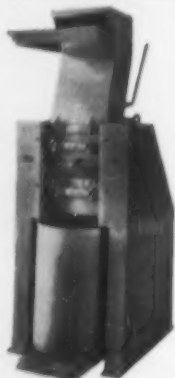
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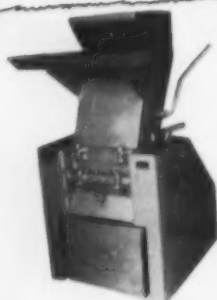
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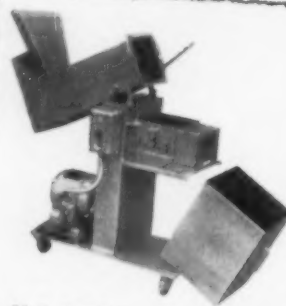
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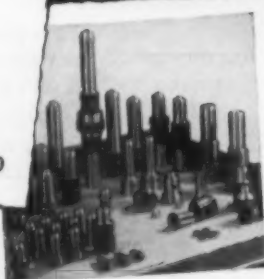


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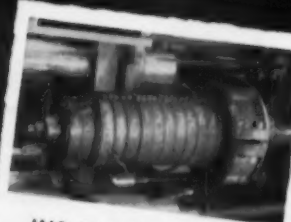
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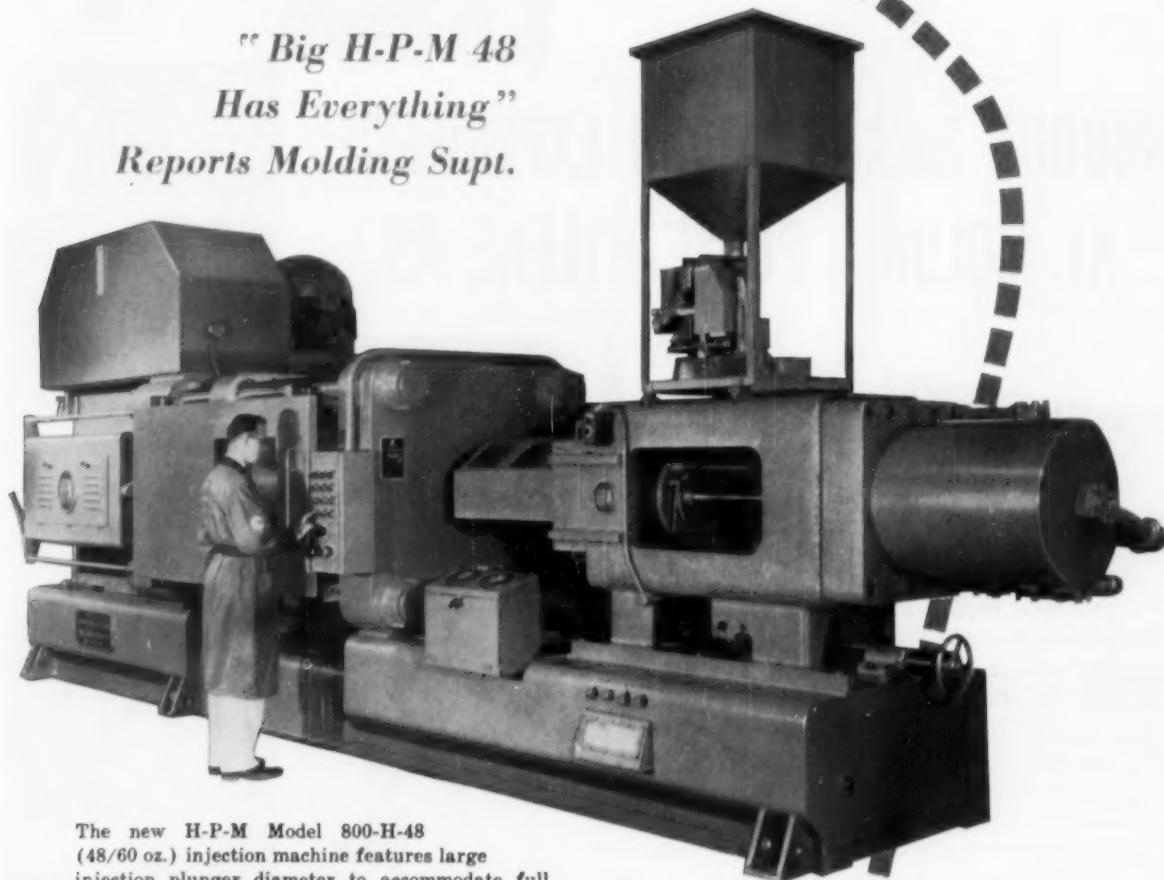
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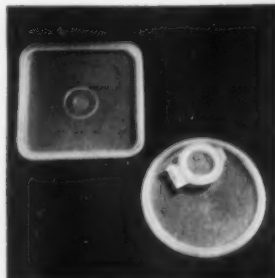
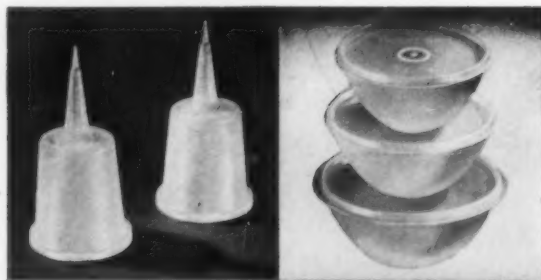
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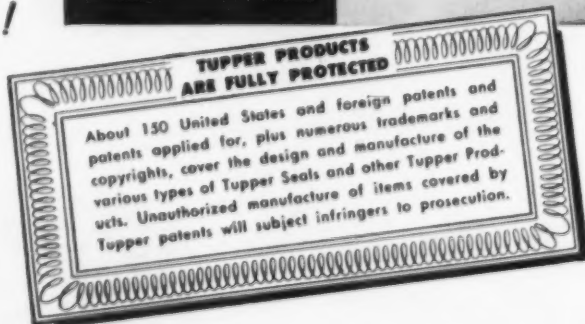
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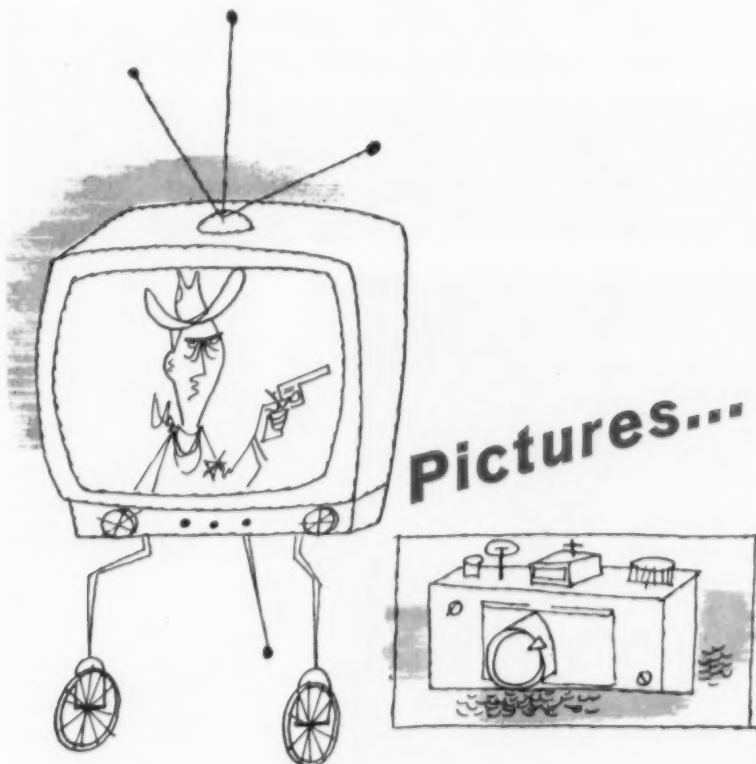


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**PLENCO #308**

**Black and Brown  
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Plenco 308 is such a modification. Compared to Plenco 300 it sets more rapidly; its shrinkage is less, minimizing warpage and it is more rigid on discharge, both factors desirable for dimensional accuracy. Those formulation changes causing the more rigid set also contribute to a smoother, more glossy finish.

Because of its rigidity on discharge, however, we cannot expect it to bend around undercuts as often is done with Plenco 300 nor does it have the machinability possessed by the 300 formulation. When these characteristics are not needed, use of Plenco 308 can result in improved dimensional accuracy, better surface smoothness and more rapid production on such parts as cases and cabinets, electrical switch parts, handles and trim and similar articles.

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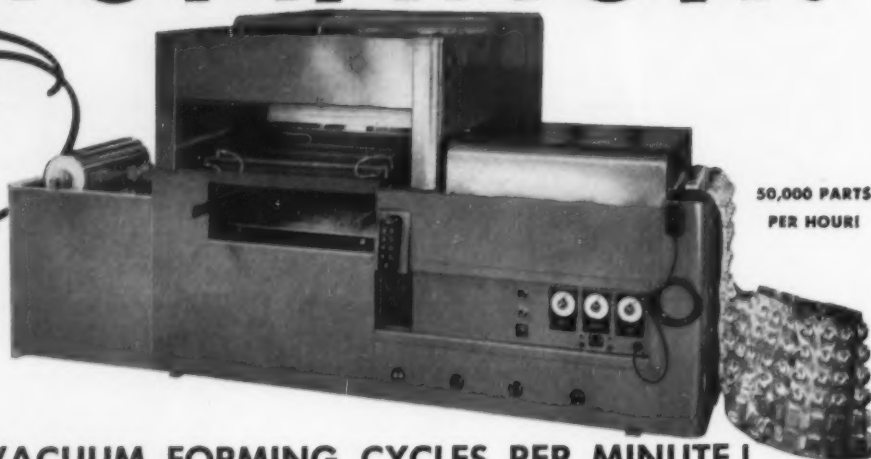
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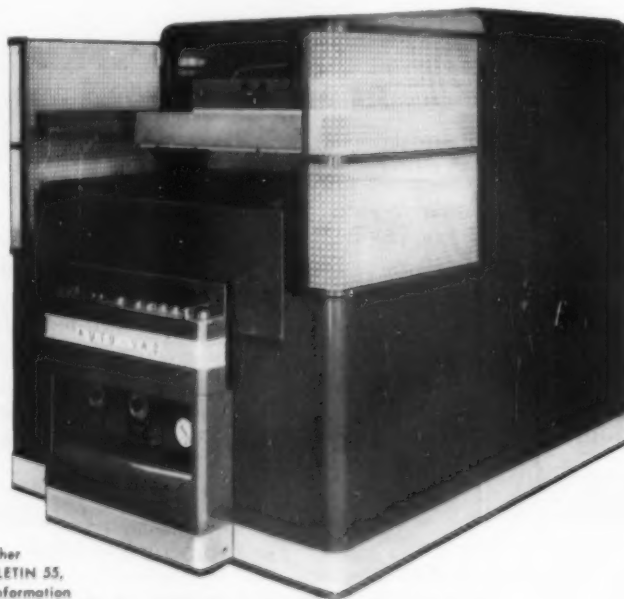
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Where more versatility is required—where complex or larger shapes are to be formed—Auto-Vac vacuum forming machines are the obvious choice. They are the most advanced machines available.

Exclusive features include—automatic high-speed cooling for faster cycling • fully adjustable clamping frame, available with adjustable temperature control • lowest consumption uniform Hi-temp Calrod heater unit • heavy duty synchronized toggle action drape mechanism • adjustable drape frame height.

Auto-Vac machines are delivered fully equipped, complete units, ready to go to work. To help you establish and maintain the highest level of production, Auto-Vac will train your personnel at its own plant.

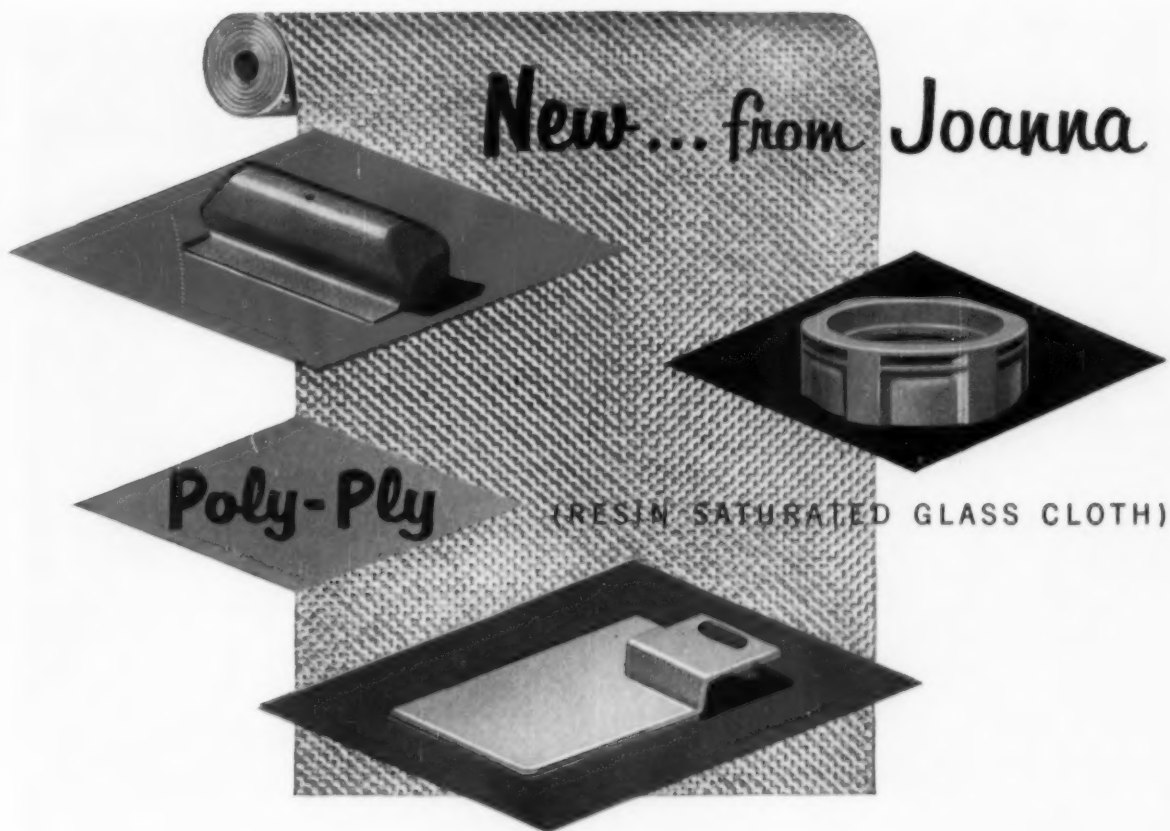


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Pioneers in the development  
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most advanced vacuum forming  
machines in the world.

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information and BULLETIN 55,  
which gives full information  
about Auto-Vac's standard  
drape and vacuum forming machines.

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## High Performance Industrial Molding Fabrics

Available now—from an established leader in textile weaving and processing—precision coated, uniformly resin-saturated glass cloths of the highest quality—JOANNA WESTERN POLY-PLY!

This is the latest addition to a long line of outstanding textile products serving American industry—produced and finished by Joanna Western Mills Company for over 60 years.

Joanna Western Poly-Ply is processed to specifications—precision saturated with fully stabilized, catalyzed Polyester, Epoxy, Phenolic or

Diallyl Pthalate resins. It is produced in 50-yard rolls up to 54" in width, interlined with polyethylene film—ready for low pressure molding by vacuum or pressure bags or matched metal molds. If stored at normal room temperature, JOANNA WESTERN POLY-PLY has a shelf life of six months.

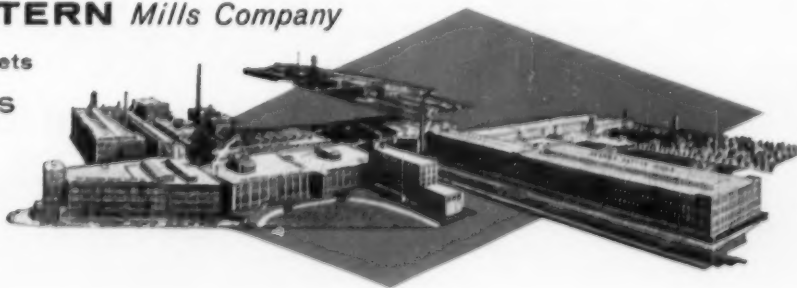
*Samples, prices and know-how of the Joanna engineering staff are available to you by inquiry on your letterhead.*

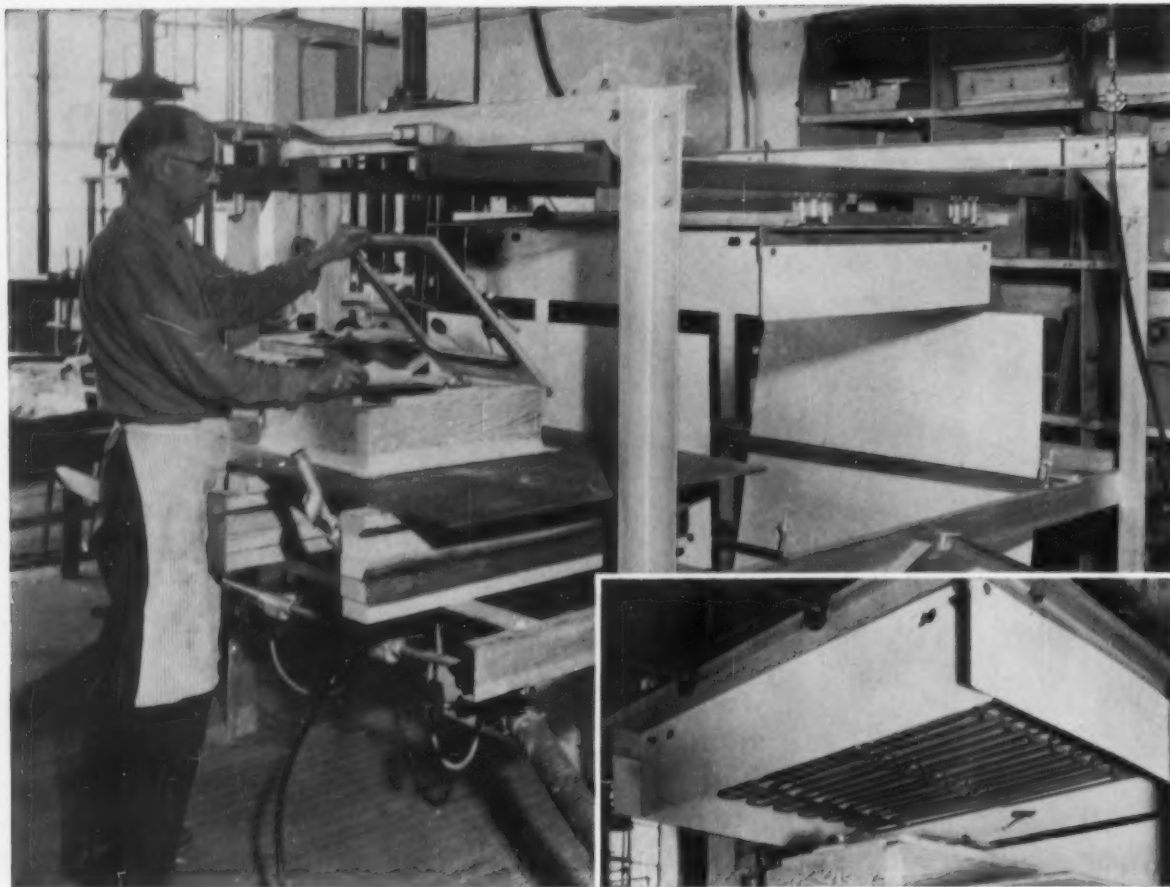
*Industrial Fabrics Division*

**JOANNA WESTERN Mills Company**

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## electric far-infrared uniformly pre-heats plastic sheets for vacuum forming . . . at low cost

To heat various types and thicknesses of plastic sheets to required temperatures for vacuum forming presented a problem to Clinwell Plastics, Inc., Buffalo, N.Y. The operation demanded precise control of both heating time and temperature on a production basis.

Two Chromalox electric far-infrared radiant panels proved the economical and efficient solution. Mounted so that distance from heater to work is readily adjustable, these panels direct a blanket of far-infrared heat onto the work. Long, far-infrared wavelength is absorbed rapidly by transparent plastic sheets. Heating time varies from ten seconds to one minute, depending upon type of material, thickness of sheet, and depth of draw.

Results are a quickly installed, low cost setup for vacuum forming. Short heat up time of equipment.

Extremely short operating time cycles. Consistently good products with low rejection rate.

This problem-solution-result approach has enabled us to help many manufacturers produce better, faster, at lower cost.

Always available to you are our research, engineering, design and modern manufacturing facilities. The world's largest factory stock of industrial electric heaters plus local stocks at strategic points. And a 33-city nationwide sales-engineering service.

Let us know your problem for controlled heat and we'll help you find the right answer—electrically.

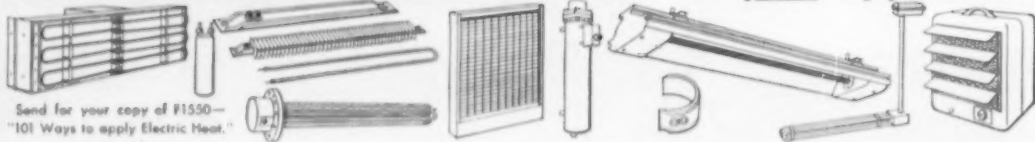
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# Troytuf

## DACRON® BLANKET

### A new and superior reinforcing material

#### *If you want—*

- better abrasion resistance . . .
- improved electrical properties, even when wet . . .
- no resin-rich corners—more uniform fiber loading . . .
- a surface or laminate with better resistance to mineral acids . . .
- elimination of pre-forming . . .
- a safer material for food or drug handling machinery or containers . . .
- a smoother, better-appearing finish . . .
- better formability after curing . . .
- low moisture absorption . . .

#### **Try Troytuf-Dacron**

Troytuf Dacron® Blanket for reinforced plastics molding is an extra-strong, light weight reinforcing material, ideally suited to molding and laminating. It differs from most other reinforcing media in that the fibres are tightly interlocked into easily-handled blanket form by a unique needle punching operation. Troytuf has excellent deep drawing, dielectric and machining qualities which open many new, potentially high volume, product applications.

**STRENGTH**—The majority of Troytuf's advantages stem from the fact it consists of pure Dacron fibres, bound together mechanically without any binder or adhesive. The material has balanced orientation, its strength being equal in all directions. Troytuf moldings exhibit good dimensional stability and are not brittle. Also, Taber Abrader tests show Troytuf laminate has a high abrasion resistance.

**WEIGHT & DENSITY**—Troytuf Dacron Blanket is 54% lighter than fibrous glass, yielding products with unusually favorable weight/strength characteristics. For example, four layers of 10 oz. blanket,

each  $\frac{3}{8}$ " in thickness, reduce down to  $\frac{1}{8}$ " at 85 psi. The blankets can be supplied in any specified widths to 110".

**SURFACE**—Troytuf moldings are distinguished by superior surface appearance. The fine, uniform Dacron fibres are almost completely masked by the resins which are used. Individual fibres are not apparent, except on closest inspection. The fibres are white and blend nicely with resins of any color.

**IMPREGNATION**—The absence of a chemical binder eliminates shelf life problems and permits optimum wettability. Troytuf can be loaded with extremely high resin concentrations. It is suitable for pre-impregnation with 2-stage resins.

**APPLICATIONS**—Troytuf Dacron Blanket is particularly suited for molding deep-draw pieces since it readily conforms to complicated shapes without requiring special tailoring. Outstanding dielectric and electronic transmission properties recommend it for printed circuitry, radomes and the like. Troytuf's good resistance to the corrosive effects of mineral acids make it especially appropriate in products subjected to such deleterious chemical action. Its light weight, high strength and good appearance are of importance in many general reinforced plastics applications.

**SAMPLES**—Troy Blanket Mills will, without obligation, supply full details and samples of Troytuf Dacron Blanket for experimental molding. *Troy Blanket Mills, 200 Madison Avenue, New York 16, N. Y.*

REINFORCING  
**Troytuf**  
BLANKETS

\*DuPont trademark

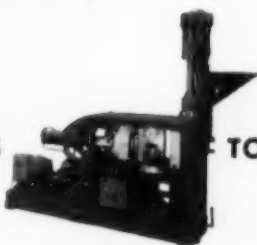


TOY CORPORATION.....

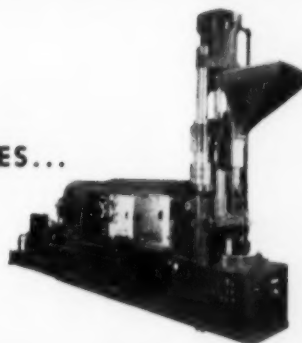
USES

# 21 LESTERS

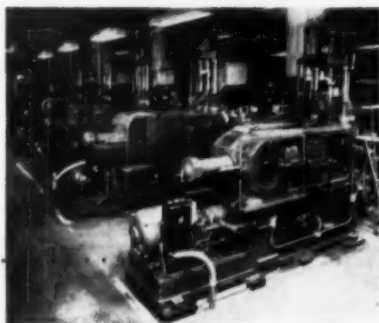
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TO 48 OUNCES...



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THEIR  
PROPRIETARY  
AND  
CUSTOM  
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# Poly-Eth News from New England



Sam Silberkraus  
Los Angeles



Dick Bishop  
Chicago



Pete Dornik  
Chicago



Vic Denslow  
Chicago



Carl Virgin  
Ohio



Reported by  
**R. S. OSBORNE**  
Spencer "Poly-Eth"  
Sales Representative

The sale of Spencer "Poly-Eth" resins in New England is far exceeding original plans. This is being achieved through Spencer's policy of doing business from the customer's viewpoint, relieving him of as much concern as possible in procuring polyethylene resins. This is accomplished in four ways:

1. **BROAD RANGE OF MATERIALS:** five for molding, five for film and paper coating, two for pipe extrusion, make available the best resin for the job.

2. **SELECTIVE SAMPLING:** Spencer is careful to submit only suitable samples, thus not wasting customer's time. "Burden of proof" of success-

ful sample runs rests on Spencer's own previous evaluation.

3. **OVERNIGHT DELIVERIES** in New England: This, on a regular routine basis, permits customers to maintain smaller resin stocks.

4. **SERVICE "BEYOND THE CALL OF DUTY":** Spencer's Technical Service is excellent and is quickly available. Beyond this, Spencer's organization can help the customer with many other business and selling problems.

The above principles are causing "Poly-Eth" sales to grow rapidly on a sound basis and are fostering excellent customer relations.

## SPENCER CHEMICAL COMPANY

**GENERAL OFFICES:** Dwight Building, Kansas City 5, Missouri

**DISTRICT OFFICES:** Dwight Building, Kansas City, Missouri, Baltimore 6600;  
500 Fifth Avenue, New York, New York, Lackawana 4-7762;  
First National Bank Building, Chicago, Illinois, ANDover 3-2656

**WEST COAST SALES AGENT:** Riverdale Plastics and Chemical Company, 8510 Warner Drive, Culver City, California, TEras 0-1000

**WAREHOUSES:** New York City; Chicago; Los Angeles; Orange, Texas

# Poly-Eth by SPENCER



Look for our new series of national ads promoting polyethylene wares.



Modern Plastics

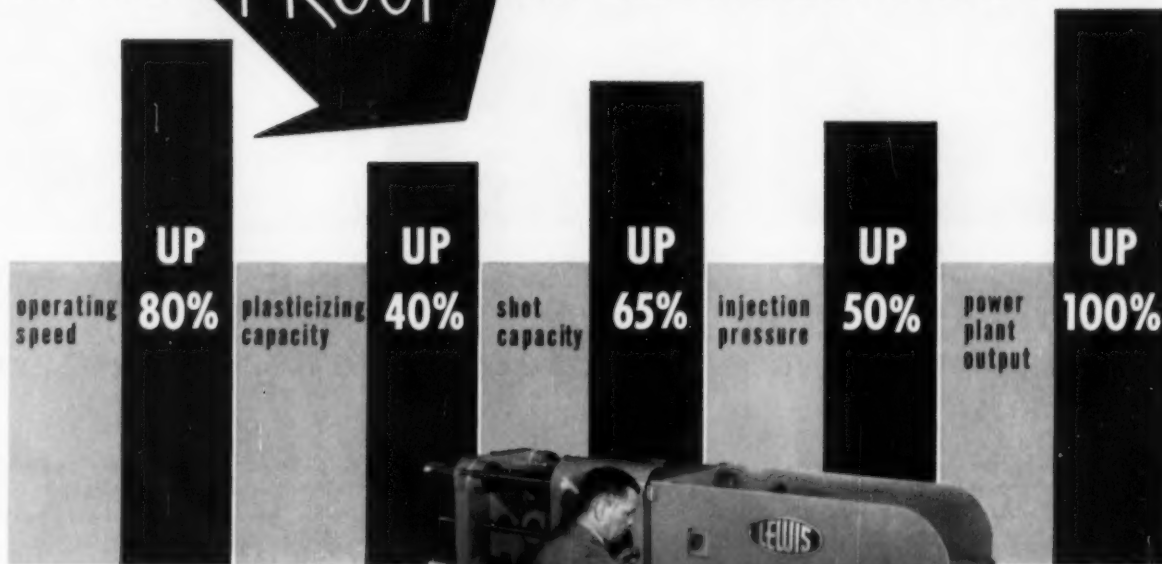


Only the name is the same! The redesigned LEWIS "4" is a completely new machine. Its increased performance boosts it into a class of its own . . . small in size, price and operating costs but equal to much larger machines in actual capacity and accuracy.

Here are the facts. New 6-second dry cycle. New 50 pound per hour plasticizing capacity. New injection pressures (up to 21,200 p.s.i.). New shot capacity of 5 ounces (polystyrene). New 10 h.p. motor. New 22 g.p.m. hydraulic pump. And . . . the largest platens in its class . . . 14" x 12 1/2" between the rods. For high volume production, the LEWIS "4" can easily be converted for fully automatic operation. Safety features include electrically interlocked gate and an emergency stop.

Compare these new performance figures with other molding machines of comparable or larger size. You'll quickly see why the redesigned LEWIS "4" is your best buy dollar for dollar. AND . . .

...THE **PROOF** IS IN YOUR PROFIT!



WITH THE  
**REDESIGNED  
LEWIS**

**"4"**



THE LEWIS WELDING & ENGINEERING CORPORATION  
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LEWIS WELDING & ENGINEERING CORP.  
11 Interstate Street • Bedford, Ohio

Please send me a copy of BULLETIN 104 describing the redesigned LEWIS "4" injection molding machine.

NAME \_\_\_\_\_ TITLE \_\_\_\_\_

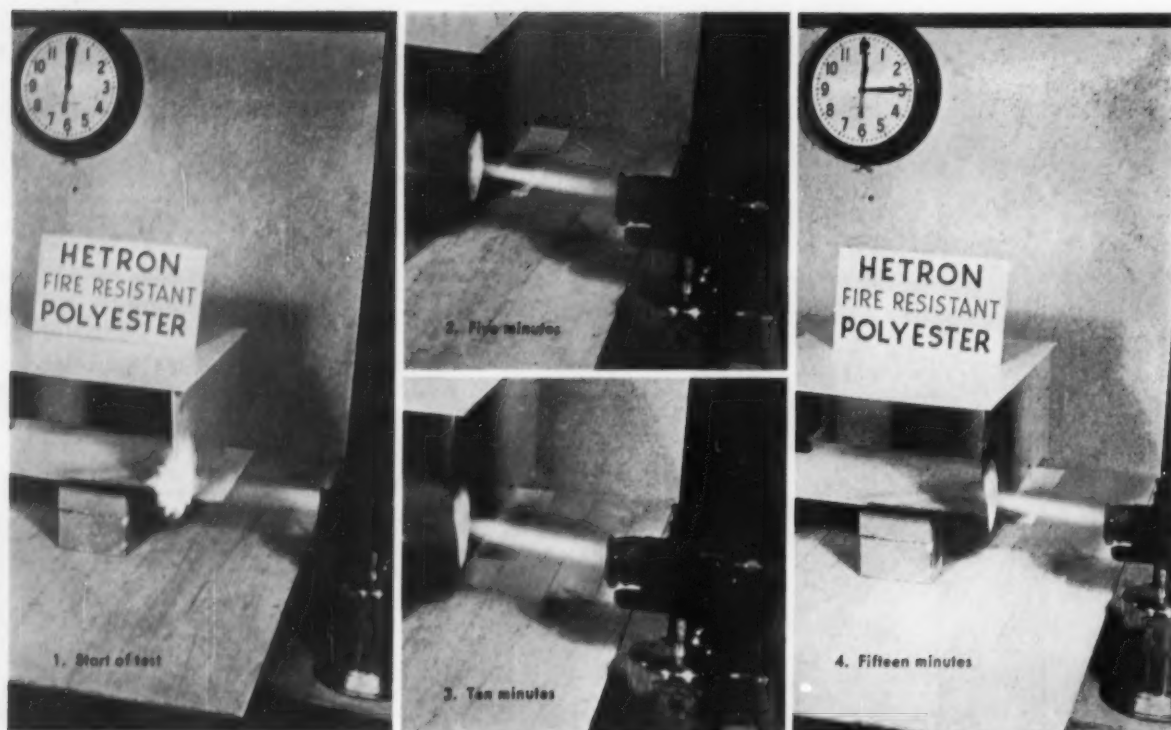
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6575-LW

ONLY THE LEWIS "4" GIVES ALL THIS AT ONE LOW PRICE



BLOWTORCH FLAME plays steadily on HETRON test structure for 15 minutes; can't start it burning.

## New material for idea-men: fire-resistant polyesters

Want to engineer high strength plus specific fire resistance into a product? Take a hard look at HETRON® polyester resins.

You can use HETRON in many places where reinforced polyesters have not been practical heretofore. HETRON will not burn, except at the point where a hot flame is directly applied. It "snuffs out" as soon as the flame source is removed.

In exploratory tests, sheets of HETRON have shown flame spreads as low as 20 by ASTM E84-50T (Tunnel Test)—compared with ratings of 0 for asbestos board and 100 for red oak.

The versatile "family" of HETRON resins can be modified and blended by the fabricator, to make possible a whole galaxy of controlled physical properties. These resins combine fire resistance with outstanding flexural strength, tensile strength, heat resistance, and very

low water absorption. Using light-stabilized HETRON, you can attain excellent resistance to weathering.

Some HETRON resins, including semi-rigid HETRON 32A, are manufactured to meet Military Aircraft Specification MIL-R-7575A, Types I and II. HETRON 92, with up to 10% added styrene, meets MIL-R-7575A, Types I, II, III.

New as it is, HETRON is already proving its merit in automobile and truck body panels and structural members; aircraft parts; large boat hulls; machine housings; radomes; electrical insulating board and parts; chemically resistant blowers, tanks and ductwork; "sandwich" structural and refrigeration panels; skylights, louvers, and industrial windows.

Is there a place in your designs for this unique combination of strength-plus-safety? To find out, write today for complete data file on HETRON resins.

Ask also for names of fabricators who can supply you with HETRON parts.

### Comparative Physical Characteristics

HETRON and 10 non-fire-resistant resins

Physical Property		Rigid Resins		Semi-rigid Resin
		HETRON 92	Avg. 10 Others	HETRON 32 A
Flexural Strength, PSI x 10 <sup>3</sup>	Room Temp.	38.6	36.4	41.8
	180°F.	25.0	18.6	23.5
Flexural Modulus, PSI x 10 <sup>4</sup>	Room Temp.	1.88	1.61	1.82
	180°F.	0.90	0.79	0.85
Tensile Strength, PSI x 10 <sup>3</sup>		21.7	22.0	21.0
Water Absorption, Pct. by Wt.		0.13	0.29	0.13

SUPERIOR PHYSICALS of HETRON show up in exhaustive tests by independent, impartial laboratories. Panels 0.1" thick, made from HETRON and 10 leading non-fire-resistant resins, contained 35-40% glass mat, 17-20% filler, and the balance resin. Note that HETRON 32A, a semi-rigid resin, is compared with non-fire-resistant rigid resins.



From the Salt of the Earth

**HOOKER ELECTROCHEMICAL COMPANY**

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# How high load capacity is built into less space in Dodge-TIMKEN All-Steel pillow block

**T**HIS rugged Dodge-Timken pillow block packs more capacity in less space than ever before. All-steel construction gives it extra strength and durability. The design is compact. No special thrust devices that take up extra space are needed—the two-row Timken® tapered roller bearing takes *both* radial and thrust loads in any combination. And full line contact between the rollers and races assures high load capacity.

The cutaway view below shows the bearing. It is of special design, with tapered bore and self-aligning spherical outer surface—never requires ad-

justment. As in all Timken bearings, races and rollers are case-carburized and have tough, shock-resistant cores under hard, wear-resistant surfaces. Under normal conditions, the Timken bearing will last the life of the machinery with which the pillow block is used.

In addition to the all-steel pillow block shown here, Timken bearings are also used in the Type "E", Double-Interlock, Type "C", and Special-Duty pillow blocks—other versatile pillow blocks in the Dodge-Timken line with a wide variety of uses in industry.

To be sure of the finest bearing steel, we make our own—America's only bearing manufacturer that does. No other bearings can give you all the advantages you get with Timken bearings. Include them in your design plans... specify them for the machines you buy or build. Look for the trademark "Timken"—it's on the bearing that makes any machine run better. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable: "TIMROSCO".



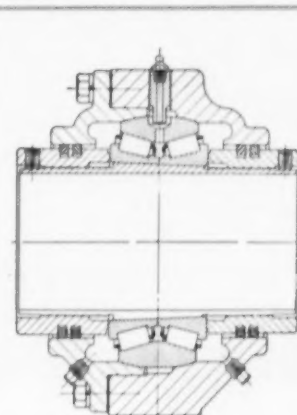
*This symbol on a product means its bearings are the best.*



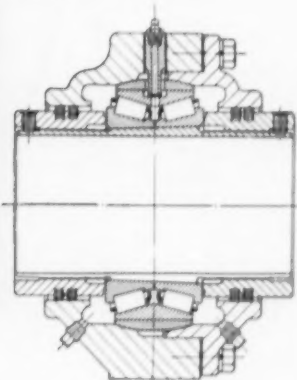
**TIMKEN**

TRADE-MARK REG. U. S. PAT. OFF.

**TAPERED ROLLER BEARINGS**



**How DODGE MANUFACTURING CORPORATION, Mishawaka, Ind.,** mounts Timken bearings in the Dodge-Timken All-Steel pillow block. Above: non-expansion block with fixed bearing. Below: expansion block with floating bearing.



NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

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Constant research and long experience combine to make all Edwards products — like the Hospital Call Button — perform *without fail* under all types of trying conditions.

Bridgeport helps companies like Edwards by molding *exactly* the right plastic components for every product and job. The attractive, functional Hospital Call Button is another fine example of Bridgeport molding skill. Perhaps Bridgeport can help you, too. Write . . .



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Glidden Cadmolith Colors offer you a combination of advantages found in no other red or yellow pigments. They are soft and easy to grind, alkali and acid resistant, insoluble in all vehicles, opaque and high in heat resistance.

Permanency of color is assured in all types of finishes when Cadmolith Colors are used as the sole pigment, and is enhanced when these colors are used as shading or tinting colors.

Available in four shades of yellow and five shades of red.



SEND FOR THIS FOLDER giving complete details, with color chips. Write The Glidden Co., Chemicals-Pigments-Metals Division, Union Commerce Building, Cleveland 14, Ohio.



**THE GLIDDEN COMPANY**  
Chemicals — Pigments — Metals Division

Baltimore, Md. • Collinsville, Ill. • Hammond, Ind. • Scranton, Pa.

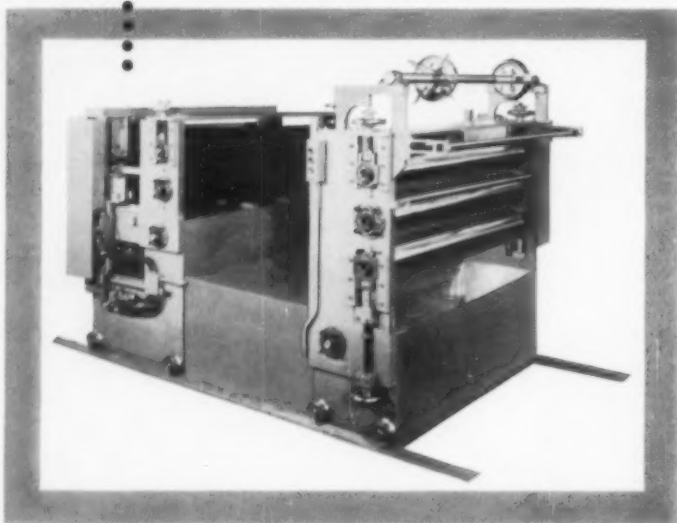


# Robbins

## ROBBINS HAUL-OFF UNIT AND SHEAR COMBINED...

This newest ROBBINS Combination is being used for production of top quality sheet and laminating. This combination mounts on base rails and comes equipped with the rails and ball-bearing rollers for easy movement. Either or both bottom and top chrome rolls can be made adjustable. Laminating rolls can be set in most practical position for any specific operation. Sub-Base can be furnished with unit so that you can feed through the bottom and middle roll. Variable speeds on all units. Used with other ROBBINS individual units or special attachments, this latest ROBBINS Combination has the flexibility to meet your requirements. Robbins dies and haul-off equipment can be used with practically all makes of extruders now on the market.

creative thinking  
*plus*  
creative engineering  
*gives you the latest*  
**in package sheet**  
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**Also rods and tubes . . .** in cellulose nitrate, cellulose acetate, cellulose acetate butyrate and ethyl cellulose.

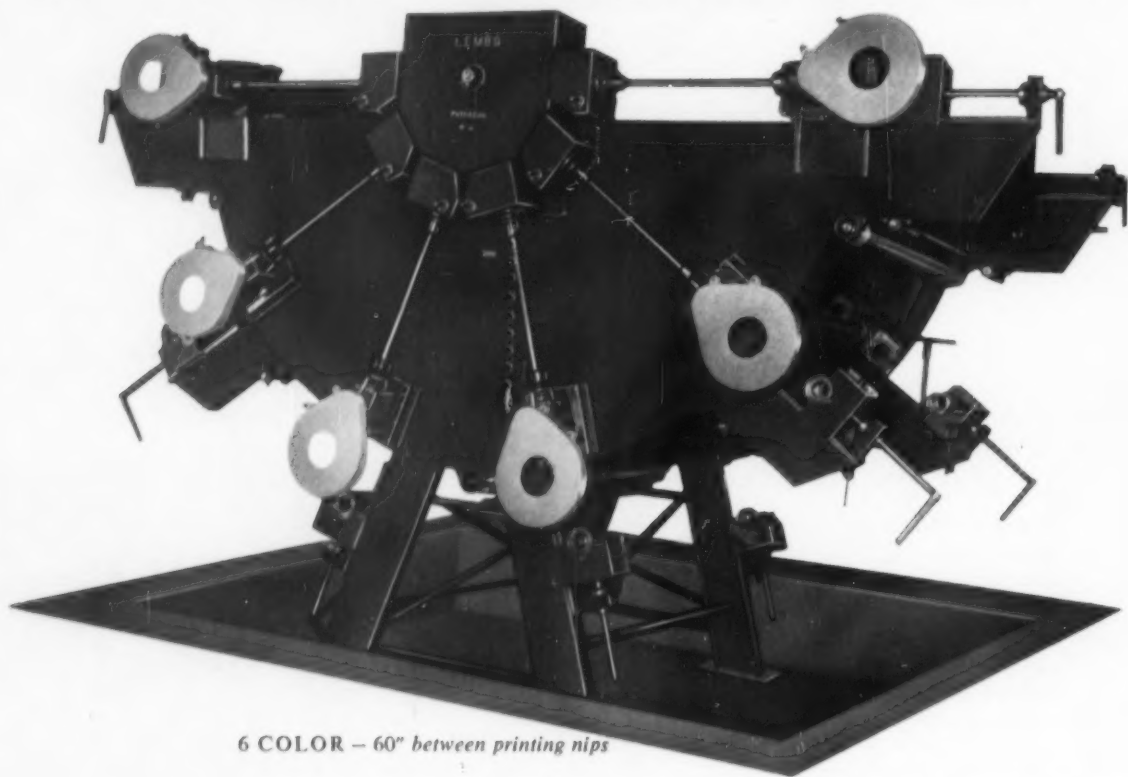
**Also cellulose nitrate sheeting**

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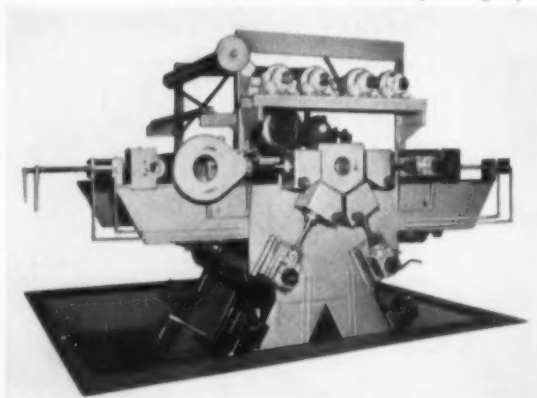


6 COLOR — 60" between printing nips

Hydraulic pressure on printing nips\* permits operator to simultaneously back away all nips. The printing machine may be stopped, but the engraving rollers keep right on turning. Ink doesn't dry on rollers, so no wash-up is necessary. Result . . . shorter shut down time.

Printers of all unsupported and supported plastic film prefer fast, quiet, accurate Lembo Rotogravure Presses. The web is carried between impression cylinders—not pulled. This assures perfect, strain-free, in-register printing at speeds up to 125 yards per minute. Your choice of hand, motor or electric eye register control.

We invite you to see Lembo Rotogravure Presses in operation. Please write or telephone Lambert 5-5555.



4 COLOR — 52" between printing nips

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\* Optional equipment available at extra charge.



# A Word From One of America's Oldest Polyethylene Fabricators and Processors—

In our considered opinion, Polyethylene plastics are entering a golden age of application and use. Its improved qualities, its increased availability, its use structurally, its future obviously is destined to become one of America's great... all purpose materials.

In the present evolution of product change and improvement, we believe you will greatly benefit by further use of this all purpose plastics material. It has many unique characteristics and attributes such as low specific gravity...excellent electrical properties, low moisture transmission, chemical inertness with flexibility and toughness. It is a superior structural material in a wide range of application and uses. Like many plastics, it has the added advantage of being translucent or available in a complete range of colors.

We, at American Agile, for years have specialized in processing...forming...molding and fabricating of Polyethylene plastic materials. Our intimate association with this material has even led us to devise new polyethylene blends for special use and has resulted in our leadership in the welding of these plastics. This knowledge...these techniques...this know-how, if you will, we believe is an all important ingredient in your full utilization of Polyethylene plastics in the production of your products.

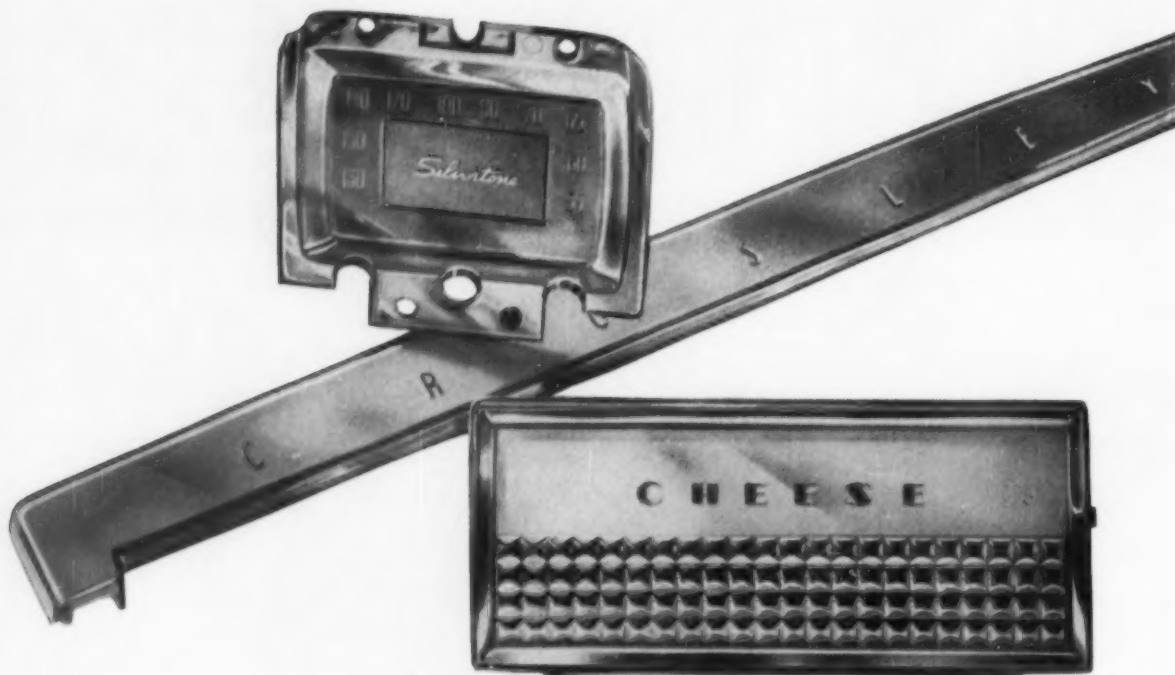
May we talk with you further about it?

*Fabricators and Processors of Polyethylene—for Industry*

- AMERICAN AGILE CORPORATION •
- 5461 Dunham Road • Maple Heights, Ohio •

*Established in 1932*





Sold burnished gold, costly silver flecks on a sky-blue field, soft amber—these and a host of other colors and finishes are given to plastic parts by Amos Molded Plastics, Edinburg, Indiana. Amos uses a CVC high-vacuum coater to achieve this rich beauty with inexpensive aluminum and lacquers.

## How vacuum metallizing gives customers the color they want . . . at a profit to the molder

A CVC high-vacuum coater is helping Amos Molded Plastics meet an increasing customer demand for metallic-colored plastic parts.

In its coater Amos gives inexpensive plastic parts a rich, metallic luster—at a few cents per thousand. Using various lacquers Amos can produce a rainbow of colors and finishes—all highlighted by their metallic backing.

**Easy to operate.** Even inexperienced help can master the vacuum-coating

process in a few hours. Following simple instructions, they can turn out flawless pieces by the hundred.

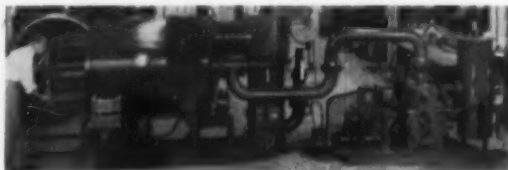
The operator simply inserts racks of lacquered parts into the chamber. An efficient vacuum pumping system quickly reduces the chamber pressure and the filament is heated to evaporate the aluminum. Immediately the aluminum condenses on the parts; they can be removed at once.

**High production rate.** This cycle can be

repeated two, three, or even four times an hour, depending on the base material of the parts. A few ounces of aluminum can cover *thousands* of parts. The process works as well with basic metals as with plastics.

**For information and assistance.** We'll be glad to share our experience in vacuum metallizing and associated lacquering operations to help you set up your own system. Write for literature on our complete line of high-vacuum coaters.

Amos Molded Plastics uses a 48" CVC vacuum coater, similar to the unit illustrated, to process as many as 4,000 parts a day. Smaller-sized models, also available from CVC, provide economical operation for short production runs. Units are delivered with all necessary equipment and controls—ready to install.



Headquarters  
for High Vacuum

**Consolidated Vacuum Corporation** Rochester 3, N. Y.

a subsidiary of CONSOLIDATED ENGINEERING CORPORATION, Pasadena, California

CVC sales now handled through Consolidated Engineering Corporation with offices located in: Albuquerque • Atlanta  
Boston • Buffalo • Chicago • Dallas • Detroit • New York • Palo Alto • Pasadena • Philadelphia • Seattle • Washington, D. C.

**Modern Plastics**



## For PLASTICS — WORBLA

Manufacturers of plastics for over thirty years.

**WORBLA-PLASTICS** have proved their worth  
So that you may see for yourself — we shall  
gladly provide you with samples.



— Celluloid in sheets, tubes and rods.



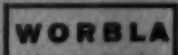
— Cellulose Acetate in sheets, tubes and rods.



— Acetate powder for injection moulding and  
extrusion.

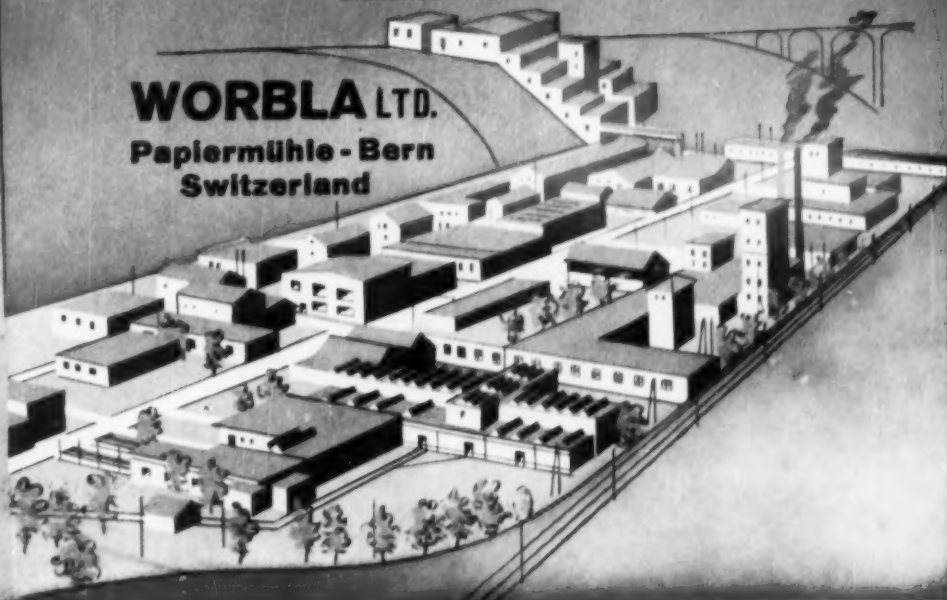


— PVC (Polyvinylchloride) in calandered and  
pressed foils and sheets, tubes, rods and pro-  
files. Compounds for injection moulding and  
extrusion.



— Nitrocellulose for lacquers and technical  
uses.  
Bleached linters

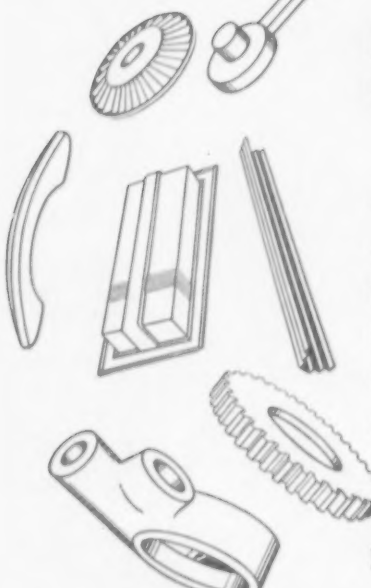
**WORBLA LTD.**  
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## ENGINEERING . . . The Basis of QUINN-BERRY Service

When you consult Quinn-Berry for molded plastics, a competent, experienced engineering staff tackles your requirements right in the planning or blueprint stage. From that point to the finished product, your molded plastics are under the supervision of these Q-B engineers every step of the way. And these steps include precision mold-building in our own machine shops by some of the finest craftsmen in the country, skilled production on modern presses, and any type of finishing required. Thus, in molded plastics, Quinn-Berry offers a complete service with undivided responsibility.



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Townsend 8-2577

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**MILWAUKEE, Wis.**  
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Greenfield 6-7161

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Harwood Molded Products  
Fairport Road  
941

**BRONXVILLE 8, N.Y.**  
Edwin S. Dunbar, Jr.  
64 Kensington Road  
Deerfield 7-7709

**DAYTON 9, Ohio**  
G. R. Vines  
637 Monterey Avenue  
Walnut 5174



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## PLASTICS

MOLDERS OF ALL TYPES OF THERMOPLASTIC MATERIALS

# HIGH-FLYING LUXURY FOR EASTERN AIRLINES

*New fleet of "Golden Falcons" features decorative materials surfaced with* **NEW DU PONT MYLAR\***

POLYESTER FILM



"MYLAR," laminated to perforated backing, gives the illusion of open sky to lounge and cabin ceilings in the "Golden Falcon."



SCUFF PLATES throughout the plane use a silver sheet of durable metalized "Mylar"; this new material will not tarnish or embrittle.



BULKHEAD PANELS employ a sheet of gold "Mylar" laminated to rigid backing, which lends striking depth and sheen to cabin area.



VALANCES use decorative "Mylar" film that's smart, practical. Lighting troughs of metalized "Mylar" disperse light evenly.

## New beauty...economy in decorative materials made possible by strongest plastic film

Decorative materials surfaced with Du Pont metalized "Mylar" polyester film highlight interior decor of Eastern Airlines' new one-hundred-million-dollar fleet of "Golden Falcons." This thin, remarkably strong transparent film—metalized in silver and gold—gives a dramatic new beauty and luxury look to ceilings, bulkheads, valances, seat frames, scuff plates and handrails.

Bonded to a backing material, then embossed, metalized Du Pont "Mylar" can be used to create unusual styling effects in a wide range of colors. This decorative surfacing material has high abrasion resistance, is stain-proof and wipes clean without smearing. The material also cuts costs in production . . . it's easily installed and can be shaped smoothly around corners and edges.

Metalized "Mylar" is also being used for interior trim in late-model cars. Other applications include leather

goods, book covers, kitchen appliances, apparel accessories.

How about the products you design? Interested in finding out how these decorative, yet practical effects can help increase the over-all value of your product? Mail the coupon today for swatches of laminations surfaced with "Mylar," and the names of manufacturers who sell the finished metalized material.



\*Du Pont Trademark Reg. U.S. Pat. Off.

**BETTER THINGS FOR BETTER LIVING  
... THROUGH CHEMISTRY**

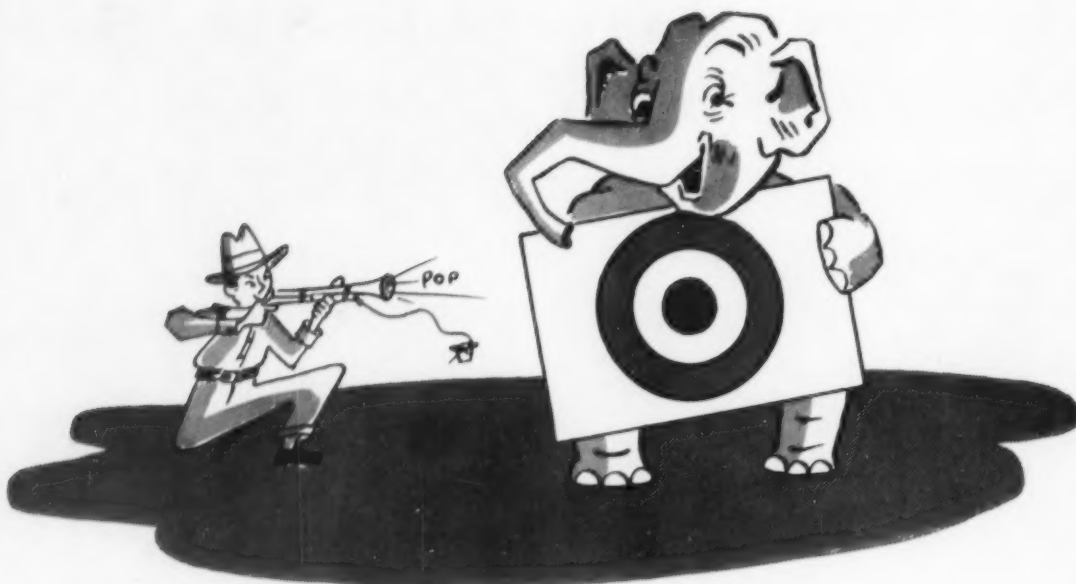
E. I. du Pont de Nemours & Co. (Inc.)  
Film Dept., Room M-1, Nemours Bldg., Wilmington 98, Del.  
Please send me sample and further information on  
"Mylar" polyester film.

Name

Firm

Street Address

City  State



# no one can hunt **ELEPHANTS** with a **POP GUN**

We at PEERLESS know you can't do a sound marking job with inferior equipment. Outdated marking machinery, as you well know, will tend to slow production and make costly errors. Look around your plant . . . decide for yourself whether you're hunting elephants with a pop gun!

Whether it be hand, air or electrically operated, marking machinery . . . remember PEERLESS has the outfit to best suit your needs. You'd be amazed at how much in time and money PEERLESS can save you.

Call or write us about your problem. We'll solve it.



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BRANCH OFFICES: BOSTON • CHICAGO • Peerless Roll Leaf Division • GANE BROS. & LANE, INC.

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EXON: each resin engineered for a specific problem



# EXON 481

specifically for

## CONSTRUCTION COATINGS



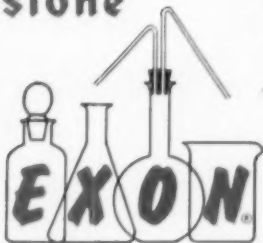
Site application of colorful, abrasion-proof coatings that last is now possible with the development of EXON 481 resin.

Simply sprayed on by a gun with 60 lbs. pressure over a prime coat, the stainproof, scuffproof sheeting dries the instant it is applied. Application is so quick and easy that the most complex shapes are no problem. No loose ends, seams, laps or joints.

EXON 481 has exceptional tensile strength — over 1000 lbs. per square inch with an elongation factor up to 200%. It is soluble in ketones, compatible with plasticizers, stabilizers and all pigment types.

As a result, coatings of the most decorative, attractive colors can be formulated. All completely washable, they ruggedly resist fading or cracking.

**Firestone**



*For complete information or technical service on EXON 481 and on all the resins in the ever-growing EXON line, call or write:*

### CHEMICAL SALES DIVISION

FIRESTONE PLASTICS COMPANY, DEPT. 62C, POTTSTOWN, PA.  
DIVISION OF FIRESTONE TIRE & RUBBER CO.



**WELKOTE**—Wellington Sears nylon backing fabric, when neoprene or vinyl-coated, combines light weight plus strength for a multitude of protective covering uses. Besides all-weather hatch tents for shiploading, these include playing field covers, machinery and freight tarpaulins, fumigation tents, etc.



## Wellington Sears fabrics back up the versatility of these coated materials



For coated auto and furniture upholstery, luggage, handbags, wall coverings and many other end uses, Wellington Sears backing fabrics include cotton sheetings and drills, twills, sateens and ducks; spun rayon, "Welkote" filament nylon and other synthetics; "KnitKote" cotton knit fabric; "Lantuck" and "Lantuck-NR" (nylon-rayon) non-woven fabrics. All end-use "engineered."

American industry today is setting no limits to the possible uses of coated materials. And there's more to these materials than meets the eye. Beneath the colorful and serviceable surface, there is a backing fabric that provides the basic strength.

But there's still more to this "inside" story. Because of special problems of tear-strength, durability, flexing, weather resistance, tailoring qualities, adhesion and the like, this backing fabric must be carefully *engineered* for each type of application.

This is where Wellington Sears enters the picture. Nowhere else will you be able to match our many decades of experience with fabrics of this type. And nowhere else will you find such a complete range of different base fabrics for every conceivable plastic and rubber coating use.

Wellington Sears makes the backing fabric only—not the finished coated product. So, if you have a coating problem—or any problem that involves fabric in combination with rubber or plastics—let our experience go to work for you. For booklet, "Modern Textiles For Industry," address Dept. K-1.

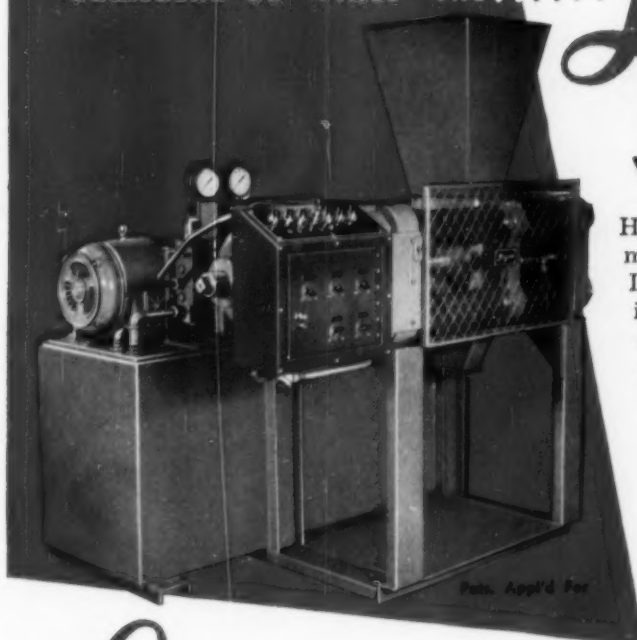
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A Subsidiary of West Point Manufacturing Company

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ON PHENOLICS OR  
MELAMINE AND UREA  
GRANULAR OR "FINES" THE.....



# Logan

## HYDRAULIC PREFORMER WILL REDUCE COSTS

Horizontal design permits gravity discharge, minimizing breakage and damage to preforms. It also makes possible automatic preforming of impact type materials rapidly and accurately. Operation is practically dust free. Rods and guides are fully enclosed. Ideal for automatic preforming of Melamine and Urea "Fines".

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30	60	125	160
200	240	280	330

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Fast, low cost production follows the selection of a Logan Hydraulic Press. In the new line of Logan Presses are a wide choice of self-contained hydraulic, fast traverse, governed pressures with up or down stroke, top or bottom transfer and with semi-automatic precise controls as well as other features that will shrink your production costs. Complete range is from 10 to 400 tons.

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complete data on Logan  
equipment before you buy.




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SPECIAL APPLICATIONS  
"FOR YOUR JOB"



HYDRAULIC DIVISION  
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SUPERIOR...**

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**508**  
**PREFORM  
ROVING**

All of our molding customers who have tried Pittsburgh's new #508 roving report excellent results. That's because PPG #508 really "outperforms" other known types of roving in producing consistently better preforms.

PPG #508 Preform Roving is definitely superior because it has been treated by a special sizing process to insure better chemical and mechanical bond between glass fibers and molding resin. Results: consistently high quality moldings, lower scrap rate, faster preforming.

Check out PPG's new 508 Preform Roving on your own molding jobs and see the difference. You can get complete information on standard packages and available sizes by simply contacting our executive offices or our district sales offices in Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis or Los Angeles. Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.

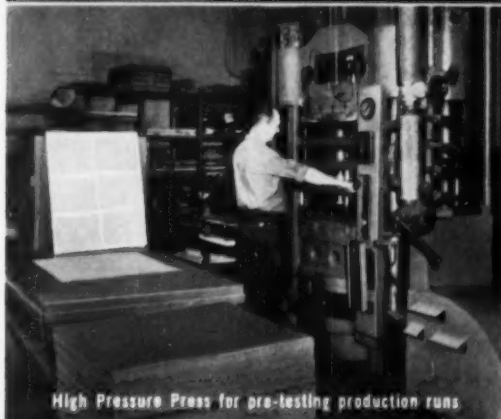


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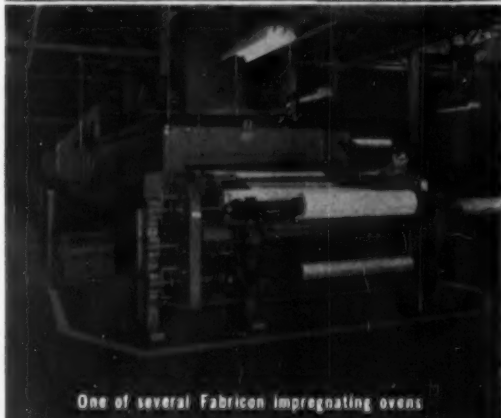
PITTSBURGH PLATE GLASS COMPANY



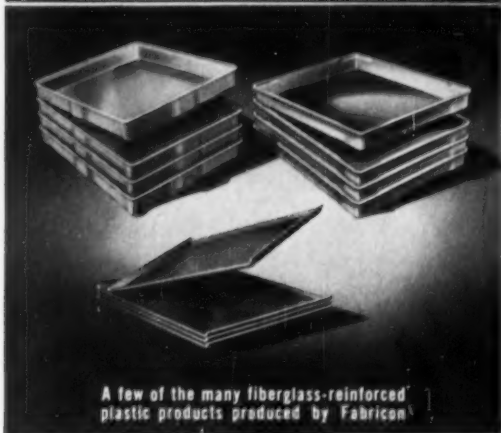
Fabricon's modern testing laboratory



High Pressure Presses for pre-testing production runs



One of several Fabricon impregnating ovens



A few of the many fibreglass-reinforced plastic products produced by Fabricon

# 4 REASONS WHY it pays to ...call **FABRICON**

Yes ... the 4 photographs tell their own story ... give concrete reasons why it pays to do business with Fabricon! It's a story of painstaking control in everything Fabricon does for you ...

- Laboratories for development of new products ... for initial product testing ... and for constant checks of production material to make sure quality is maintained!
- High Pressure Presses duplicate and pre-test your production runs, assure minimum production troubles in your factory!
- Modern impregnating ovens deliver impregnated materials within rigid specifications from run to run. Fabricon also offers you complete slitting, sheeting and die-cutting facilities ... assuring you of lowest possible cost!
- A variety of products for satisfied customers spell vital know-how and experience at your disposal!

Large and small companies throughout the world have counted on Fabricon for over 14 years. Why not you?

## **FABRICON PRODUCTS**

a Division of The Eagle-Picher Company

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Impregnating • Coating • Fiberglass Molded Products

PLANTS LOCATED AT: RIVER ROUGE, MICHIGAN • LOS ANGELES, CALIFORNIA

whenever you need

# LOW TEMPERATURE FLEXIBILITY



## SPECIFY PLASTOLEINS® 9058 DOZ AND 9057 DIOZ

Eskimos and their low-temperature problems aside—what about yours? Fabricators of plastic items will be more receptive to your vinyl products if you can offer them superior low-temperature flexibility . . . like that provided by Plastoleins DOZ and DIOZ.

In addition, these Emery Plasticizers give many other advantages to calendered and cast films, calendered sheeting, calendered and dispersion coated fabrics, and extruded products. They provide low volatility, low water extraction, excellent heat and light stability, high plasticizing efficiency and extremely low soapy-water extraction.

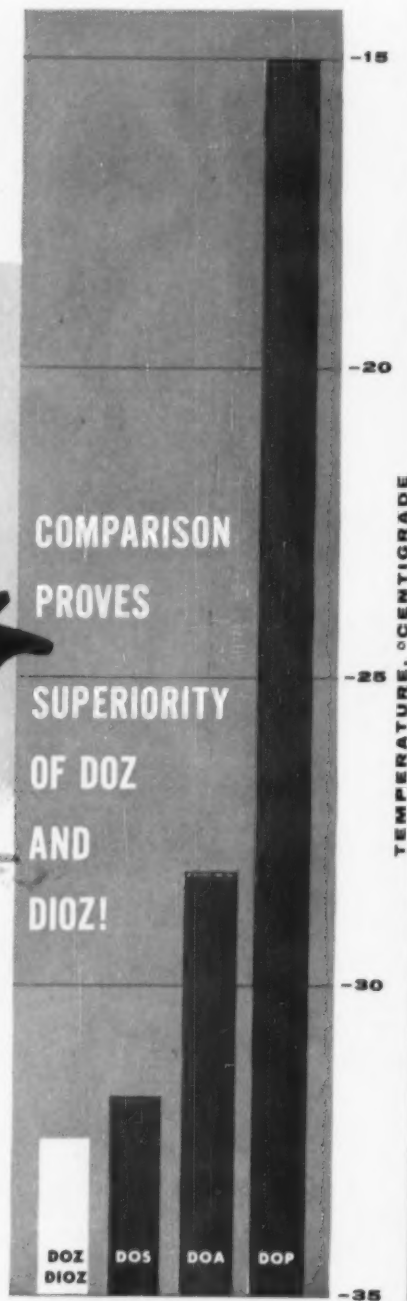
Find out how you can make your products more attractive sales-wise. Today, write to Dept. F-1 for descriptive literature and samples of Plastolein 9058 (di-2-ethylhexyl azelate) or Plastolein 9057 DIOZ (di-iso-octyl azelate).



Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio

Fatty Acids & Derivatives  
Plastolein Plasticizers  
Twitshell Oils, Emulsifiers

COMPARISON  
PROVES  
SUPERIORITY  
OF DOZ  
AND  
DIOZ!



### LOW-TEMPERATURE FLEXIBILITY

Clash-Berg T<sub>g</sub>  
at efficiency concentration

New York • Philadelphia • Lowell, Mass. • Chicago • San Francisco • Cleveland  
Warehouse stocks also in St. Louis, Buffalo, Baltimore and Los Angeles

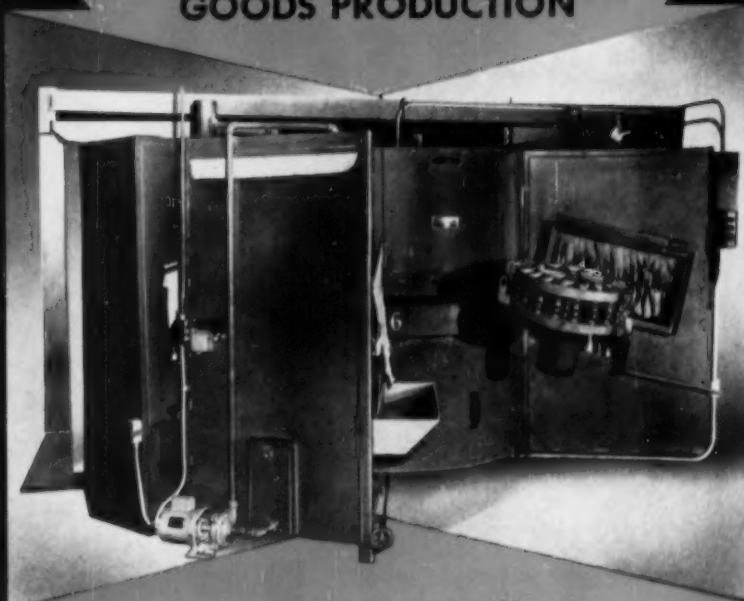
Export: 2205 Carew Tower, Cincinnati 2, Ohio

# MOLD MORE PROFITS AUTOMATICALLY!

## ROTATIONAL PLASTISOL CASTING

Profits go up when you install our fully automatic rotational casting machine for making hollow plastisol articles. It is a high speed production unit, operated by one person who handles only the raw material and the finished product.

### HERE IS THE MACHINE WHICH IS REVOLUTIONIZING HOLLOW GOODS PRODUCTION



The above rotational casting machine consists of a turret base on which are assembled six radial arms, each carrying multiple cavity molds equivalent to a 25 inch diameter molding area. The machine is adjustable from a cycle of 3 to 5 revolutions per hour and the individual spindles rotate at separately controlled speeds. The cycle of production carries the multiple cavity molds through the electric oven for progressive gelling, thermosetting and through cooling chamber, emerging with finished, resilient products. The machine is very compact and can produce as many as 1620 articles per hour. Tell us what you wish to manufacture and we will tell you how to make it faster, with more profit.

#### NEW PRODUCTS?

New products keep life flowing in any business and our rotational plastisol casting machine offers new opportunities. If you have a new product idea, call on our development department for assistance.

## THE AKRON PRESFORM MOLD CO.

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**CYCOLAC is light in weight yet rigid and tough. This lightest of all rigid thermoplastics combines high impact strength, high heat-distortion point, dimensional stability, and low brittle-point.**

**Specific Gravity — 1.01**

**Injection mold — extrude — calender.**

THE PERFECT RESIN FOR THE  
MANUFACTURE OF ANY PRODUCT  
THAT DEMANDS . . . .

- HIGH IMPACT STRENGTH
- LIGHTWEIGHT
- NON-CORROSION
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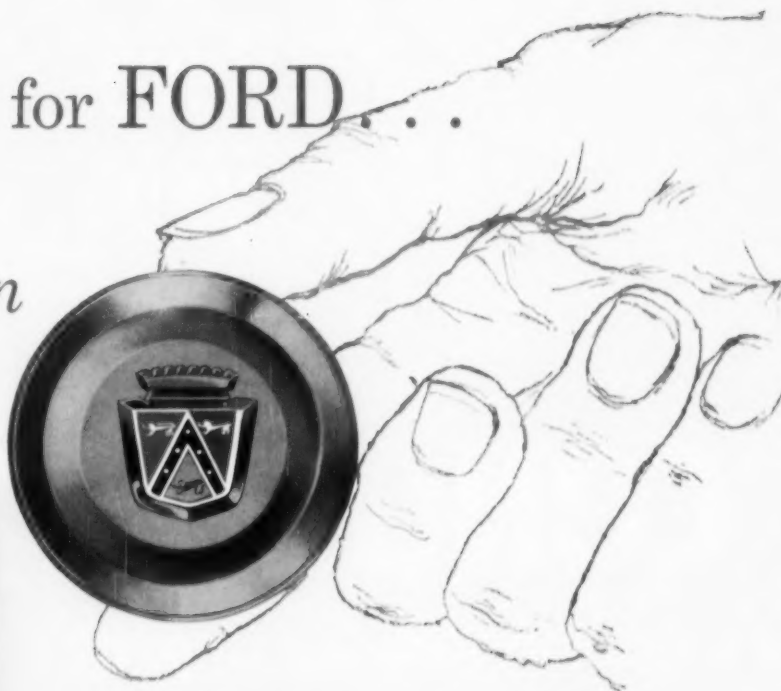
**MARBON CHEMICAL**

Division of BORG-WARNER

**GARY, INDIANA**

**MARBON CHEMICAL . . . Precision Resins for Precision Made Products**

our *fourth* for FORD...  
*another*  
*horn button*



CUSTOM MOLDED and FINISHED IN

**ERIE**

3 DIMENSIONAL PLASTICS

A repeat order is the best evidence of customer satisfaction. This is the fourth horn button we have had the pleasure of producing for the history making Ford car in the last few years.

The Ford button reproduces the Ford shield in relief on a silver background. The red, blue, black, and silver design stands out with a jewel-like brilliance which can be produced only in 3 dimensional plastics.

ERIE PLASTICS has the "know-how," plus complete facilities for plating, spray painting, hot stamping and buffing to reproduce eye-catching designs, nameplates and trademarks into plastic gems of enduring beauty.



Have  
you  
tried

# CONOCO H-340

as a secondary plasticizer for polyvinyl chloride formulations

Outstanding features of Conoco H-340 when used in polyvinyl chloride formulations are:

- Excellent light stability
- Improved low-temperature flexibility
- Economical—unequalled advantages for cost-wise formulators
- Significantly lower initial and aged viscosity in plastisols

- Tensile and hardness properties are not materially affected

Conoco H-340 is an almost water-white liquid having a viscosity of about 20 centipoises at 100°F. It is readily available in commercial quantities in either drums or tank cars.

We will be glad to give you further information and samples. Send us your request on your company's letterhead.



*Petrochemical know-how from the ground Up!*

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## CONTINENTAL OIL COMPANY

Petrochemical Department, Division P-1

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1353 No. North Branch Street, Chicago, Ill.

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VACUUM COATING?**



**I know it's low cost  
— but how do I get started?**

**Do I need  
trained operators?**

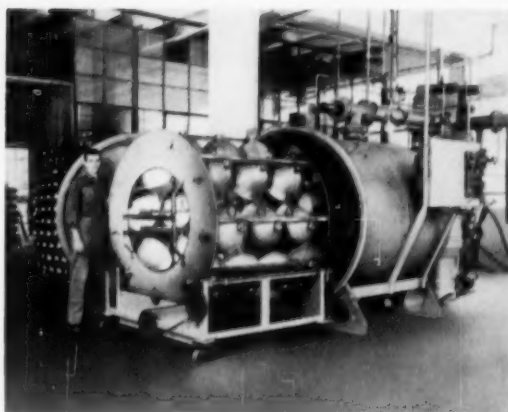
**What's the  
story on lacquers?**

**What will my  
costs be?**

**Where do I get  
experienced advice?**

**Here's how to get started with  
low-cost vacuum coating . . .**

It is really quite simple. National Research technicians have a great store of vacuum coating experience available for your use. They are experience-equipped to design a complete vacuum coating system for you. Give you an idea of your costs ahead of time. Supply you with a vacuum-coated sample of your product. Make the installation. Advise on lacquers. Train operators. Stand by to help you quickly get into profitable production. Here's the easy, sure way to use the latest, low-cost method of coating metals and plastics with beautiful metallic coatings. Send coupon.



Reflector finishing costs dropped 75% when this National Research vacuum coater replaced electroplating.

SALES OFFICES  
IN  
PRINCIPAL CITIES



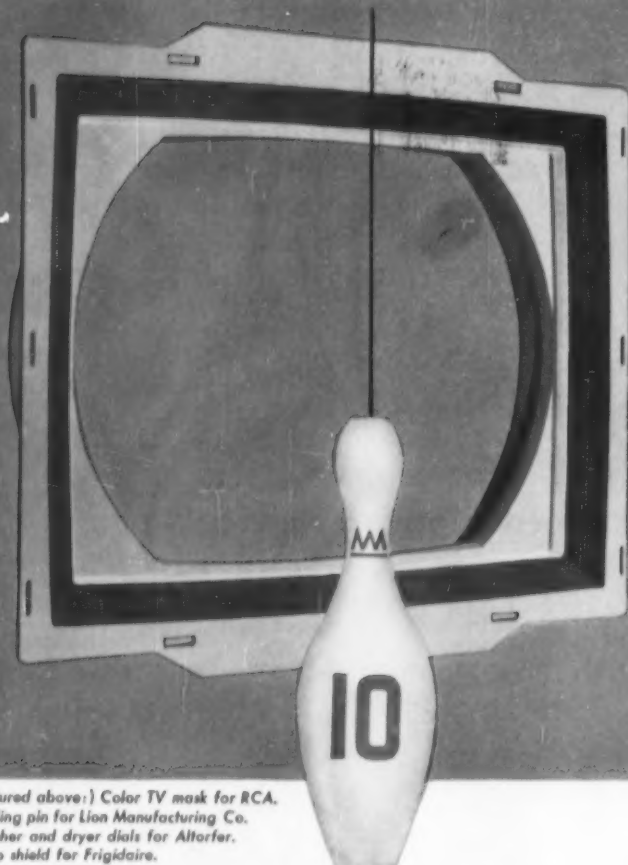
**NARESCO EQUIPMENT CORPORATION**

Subsidiary of National Research Corporation  
Dept. 191, Charlemont St., Newton Highlands 61, Mass.

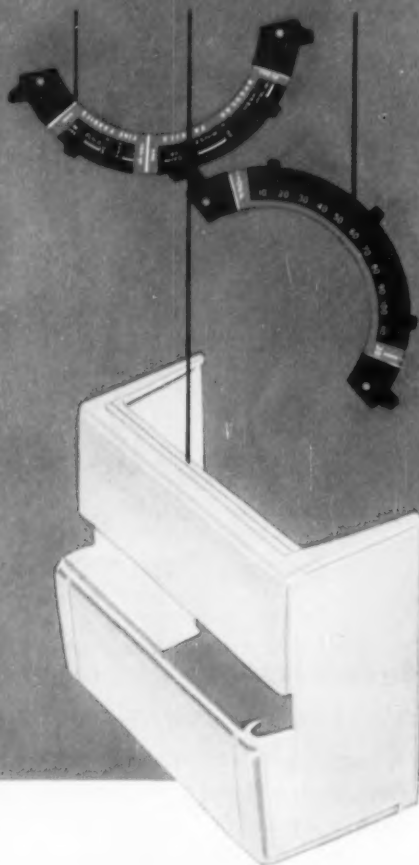
Please send me the "Rapid Cycle" Vacuum Coater Bulletin.

Name \_\_\_\_\_ Title \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

# Large or small Amos molds 'em all



(Pictured above:) Color TV mask for RCA.  
Bowling pin for Lion Manufacturing Co.  
Washer and dryer dials for Altorfer.  
Lamp shield for Frigidaire.



● **An Amos customer**—whether his product be large or small—gets, first of all, customer *satisfaction*.

**Secondly**, he gets Amos *complete* facilities, plus skilled, experienced personnel to carry his product through *every* step of specialized production—Product Design, Engineering, Mold Building, Molding (4 to 200 ounce capacity),

Conveyorized Assembly, Multi-Color Finishing, Vacuum Plating, Silk Screening, Hot Stamping, Roller Coating, Printing, Spray Painting, Packing and Shipping.

**Amos is privileged** to serve some of the best-known names in American industry. Amos invites *your* inquiry now. No obligation. Phone, wire or write.

**AMOS MOLDED PLASTICS, EDINBURG, INDIANA**

• Offices: Chicago, Detroit, New York City, Philadelphia, Kansas City, Mo.



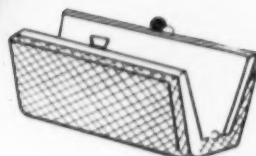
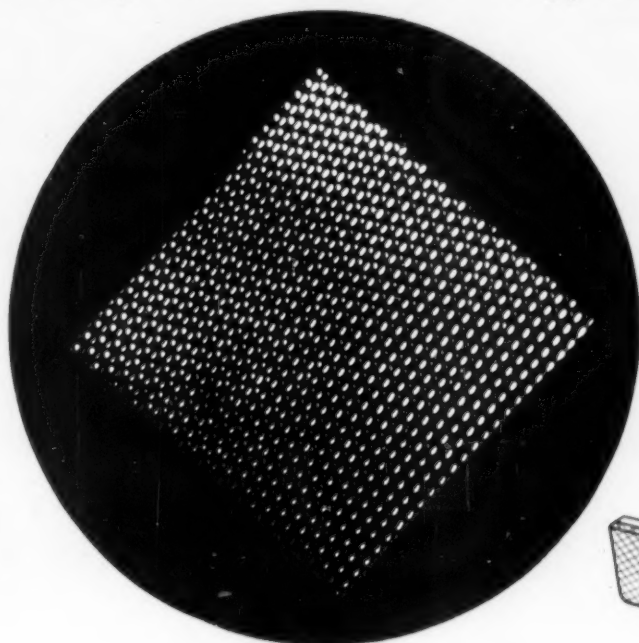
*for Plastics applications...look first to Amos*

**Amos**  
MOLDED PLASTICS...

Custom Injection  
Molding and Finishing Specialists

# MIRRO-BRITE LAMINATED AND METALLIZED MYLAR\*

*is now available for unlimited industrial applications*



**T**ake a look at the attached sample. It represents a development you can't overlook . . . (half mil) .0005 gauge aluminized Mylar laminated to 14 gauge non-migratory vinyl and dimensionally embossed. Here is the newest entry in the materials supply field with a limitless potential for many usages.

Mylar, the miracle polyester film with amazing tensile strength, embodies an unusual combination of physical, electrical, chemical and thermal properties. Combined with metallization, it offers

designers and manufacturers unlimited opportunities for novel effects and functions.

MIRRO-BRITE MYLAR can be furnished in laminations to paper, plastics, leather, board, textiles and other materials. It can be embossed, die-cut, printed and processed in many ways. A wide variety of color finishes, embossing patterns and special effects available in continuous rolls in 40 and 54" widths or cut-to-size sheets. Send for additional information, prices and data now. Samples upon request.

## COATING PRODUCTS

Dept. MP1 101 WEST FOREST AVENUE ENGLEWOOD, N. J.

\*Mylar is DuPont's registered trade mark for its brand of polyester film. See DuPont "Mylar" ad on page no. 45

**ALSO MIRRO-BRITE ACETATE, POLYSTYRENE, BUTYRATE AND ETHYLCELLULOSE**



## More Machine for Your Money!

**M**achine for machine...in each class size...the Fellows line offers you greater opportunity for profits...whether you are mass producing consumer items...or molding extremely difficult industrial pieces.

In terms of **SPEED...FULL AUTOMATIC OPERATION...TEMPERATURE CONTROL...INJECTION RATES...FAST SET UP...EXTRA SAFETY...** and just plain ordinary **DEPENDABILITY...** Fellows injection molding machines offer you the ultimate in high level performance. For specific proof: ask any Fellows Plastics Specialist for a "tell-all", feature-by-feature comparison with any other machine on the market.

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**injection molding equipment**

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*Allied-Chemical integrated!*  
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FEW PRODUCTS ARE MARKETED  
WITH ALL THE ADVANTAGES

OF *National Aniline*

# ADIPIC ACID

$\text{HOOC}(\text{CH}_2)_4\text{COOH}$

Only once in a lifetime does this happy combination of plant, process and product advantages occur. National Aniline's new production of Adipic Acid at Hopewell, Virginia is exceptional in every respect. It represents a wholly-new, major integrated source of a much-needed, versatile dicarboxylic acid for the rubber, plastics, plasticizer, synthetic lubricant and chemical industries.

Hopewell is now producing important tonnage of ADIPIC ACID. Its output can be expanded as fast as the need arises. We welcome inquiries from present and prospective makers of adipates, adipic polyesters and polyurethanes for samples, technical data, price and delivery quotations.

## SEND FOR TECHNICAL BULLETIN I-12

This comprehensive 8-page technical bulletin on National Adipic Acid gives physical and chemical properties; principal reactions to the carboxyl and alpha methylene groups; solubility curve, and suggested uses with copious literature references. Your copy will be sent without obligation on request.

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Los Angeles Columbus, Ga. New Orleans Chattanooga Toronto



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**NRM "FIRSTS"**

*in thermoplastic*  
**EXTRUDER**  
**development**



NRM 2½" Electrically Heated  
HIGH SPEED Extruder



Coming up *for you* in 1956 —▶

# Our new **HIGH SPEED** Extruder heads the list . . .

Last year we made available to the plastics industry our 20:1 Le/D ratio Extruder, which improved the quality of extrusions and increased production from 30-50% over conventional machines of the same size. This year we are able to improve quality even further, and considerably increase even this production record with another NRM "first" . . . our new HIGH SPEED Extruder. Here's the story:

**WHAT IT IS** — The NRM HIGH SPEED Extruder is like our 20:1 ratio Model 55 in most respects. It has the same long cylinder and other advanced features, PLUS a feed screw of special design which can operate at twice the r.p.m. of the Model 55, or faster. It is the first commercially available high speed machine approaching the conditions for adiabatic extrusion . . . the *ideal* way to heat, plasticise and extrude thermoplastics.

Adiabatic extrusion is attained under certain mechanical and thermodynamic conditions which are a function of speed, length, diameter, helix angle and flight depth of the feed screw. With the right balance of these factors, the screw can best achieve adiabatic extrusion when rotating at extremely high speeds. Success in applying these principles means new horizons in profit-making for the plastics ex-

truding industry . . . and NRM has taken the initiative all the way along in developing and building high speed extruders.

Pilot models of our HIGH SPEED Extruders have already established records in extrusions quality and production for their types. A 2½" Model 50 is being tested, under production conditions, at Yardley Plastics Co., Columbus, Ohio. A 2½" Model 55 may be seen in operation at our Akron laboratory.

**WHAT IT DOES** — First, the new NRM HIGH SPEED Extruder considerably increases both the production and quality of extrusions over even that of our Model 55. The Polyethylene pipe tests shown here will help you appreciate this more fully. Second, the HIGH SPEED Extruder is extremely versatile . . . with the *one* machine, a wide range of extrusion sizes can be produced economically by running at either high or conventional speeds, and, if desired, using conventional-type screws for the low speeds.

**NRM HIGH SPEED** Extruders with screws for Polyethylene extrusion as shown in the tests are available now. Results of extruding other plastic materials at high speed have been so encouraging that we are now developing screws for running *all* types of thermoplastics. These will be available in the near future.

## TYPICAL HIGH SPEED EXTRUDER TEST RUNS

DATES: 10/4/55 — 10/13/55

SCREW: Special High Speed Screw, 2½" dia., 15:1 Le/D ratio

RUNS	R.P.M.	LBS./HR.	AMPS*	SCREW TEMP.	CYLINDER TEMP.	FEED TEMP.	SCREENS	SHAPE EXTRUDED	COMPOUNDS (Polyethylenes)
1	120	156	41	Neutral	325-1 325-2	140	16 60 120	1¼" Pipe	Compounds of four different suppliers were used in these test runs.
2	145	177	56	Neutral	300-1 300-2	140	120	1¼" Pipe	
3	148	184	58	Neutral	315-1 310-2	140	120	1¼" Pipe	
4	125	188	50	Neutral	270-1 300-2	187	16 30 120	1¼" Pipe	

\* 30/10 H.P. U. S. Varidrive: 91/57 AMPS Rating @ 230 Volts

WRITE TODAY FOR MORE INFORMATION on the NRM HIGH SPEED EXTRUDER. See for yourself how it can increase profit on extrusions produced in your plant.

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The  
OPPORTUNITIES  
in  
ENGINEERING  
and SCIENCE



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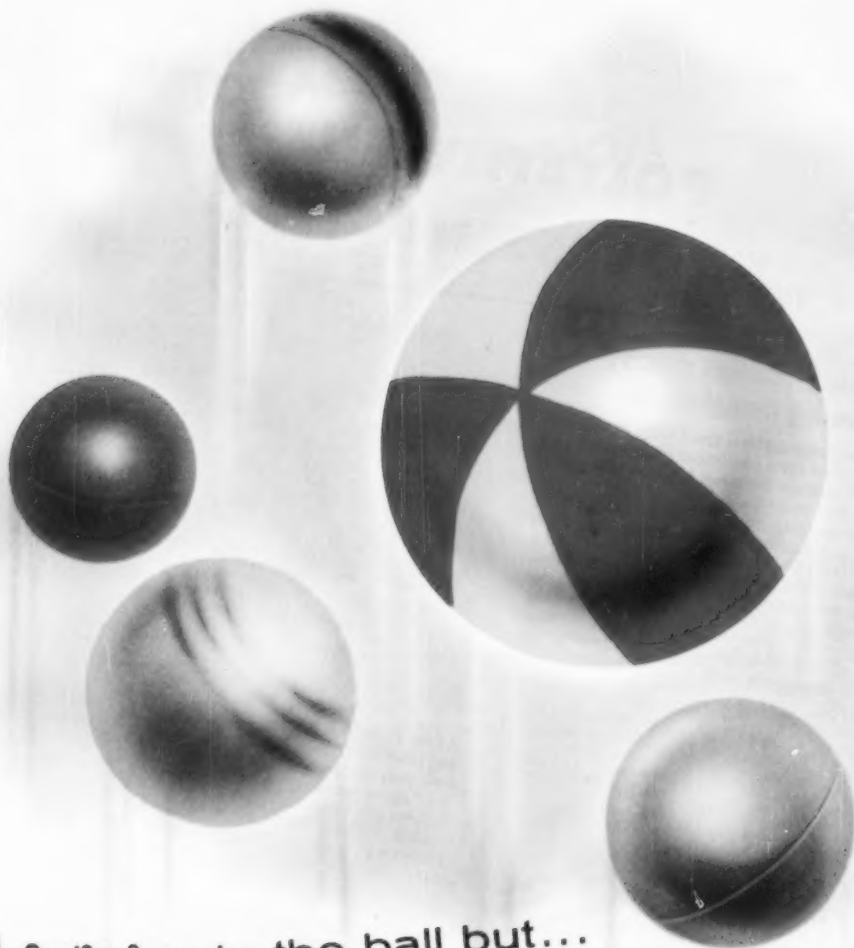
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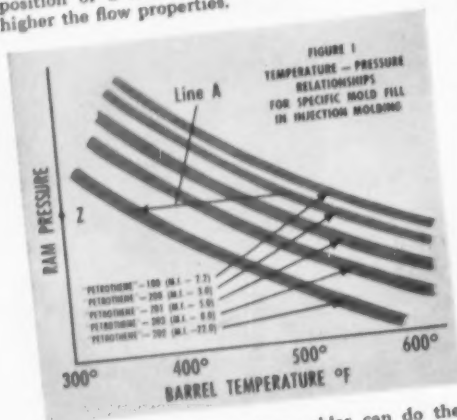
# U.S.I. POLYETHYLENE PROCESSING TIPS

## Increase production rates by choosing the right resin

Choice of the polyethylene resin with flow properties best suited for a particular application can make the difference between high or low profit to the injection molder.

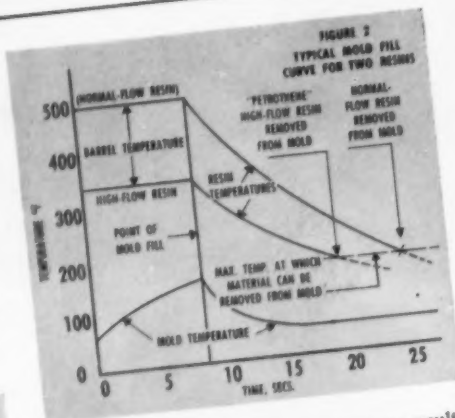
Which is the best resin? This of course will vary from application to application, but here is some background information that will help you find the right answer for your application.

The curved bands in Figure 1 represent injection molding conditions for resins exhibiting several different flow properties. The lower the position of a resin's band on the graph, the higher the flow properties.



These curves show that a molder can do the same molding job at a lower barrel temperature — without increasing his ram pressure — simply by going to a higher-flow resin. Line A, for example, shows that the job can be done at pressure Z with PETROTHENE® 200 at 500°F barrel temperature, can be done with PETROTHENE 201 at 470°F, PETROTHENE 203 at 430°F, or PETROTHENE 202 at 370°F.

What does this mean in terms of cycle time and production rates? Refer to Figure 2, which shows typical cooling curves for an injection molding cycle at two different barrel temperatures. The curve shows that the "normal-flow" resin, operating at a barrel temperature of 500°F in this particular mold, takes 25 seconds to reach release temperature, while the "high-flow" resin reaches this same temperature level in 21 seconds — a saving of about 16% in cycle time. Of course, these times and temperatures apply only to this particular mold. Other molds will have greater or lesser savings, but the same general principle applies.



Aside from the production rate increase resulting from this cut in cycle time, the use of higher-flow polyethylene resins has other advantages — 1. Higher surface sheen, 2. Lower warpage, 3. Less shrinkage.

One caution. When using high-flow resins, be sure that there is adequate back-pressure to eliminate the possibility of air voids appearing in the molded part.

## Plant performance tells the story

Molders who have been using U.S.I.'s PETROTHENE 202 (Melt Index — 22) for molding large-size housewares report production increases of as much as 35%. Other high-flow types of U.S.I. PETROTHENE — types 201 and 203 — have been chosen because they give the desired degree of flexibility to the molded part, as well as for the production increase.

## Call on U.S.I. technical service

Because there's no single answer to all molding and extrusion problems, each has to be tackled individually. U.S.I. Technical Service Engineers are ready to work with you toward the solution of any of your polyethylene processing problems.



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7" x 14" x 28"  
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When war forced our Government to produce synthetic rubber in great quantities, the acceptance of the challenge by American industry was a tribute to American engineering genius. In 1942, Adamson was given the assignment of developing and producing baling units which would handle the job efficiently—accurately.

Within approximately twenty weeks designs had been completed, patterns made, material collected and fabricated, and our first baling presses shipped to various synthetic rubber plants.

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Today, those presses are in successful operation, and are being reproduced in quantities to handle 1955 requirements for nearly all of the large, synthetic-rubber manufacturing plants in the United States and Canada. European manufacturers are building their own to the original Adamson design.

In today's presses, no change in design is required, although, of necessity, these same baling units have been called upon to increase productivity by two and even three-hundred percent of the original estimated capacity. We believe that this is an outstanding example of FUNCTIONAL DESIGN WITH PROVISIONS FOR INCREASED PRODUCTION DEMANDS.

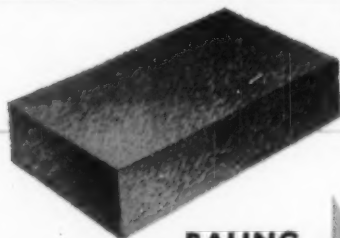
## Adamson United Company

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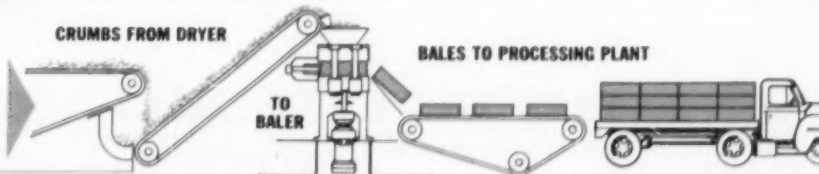
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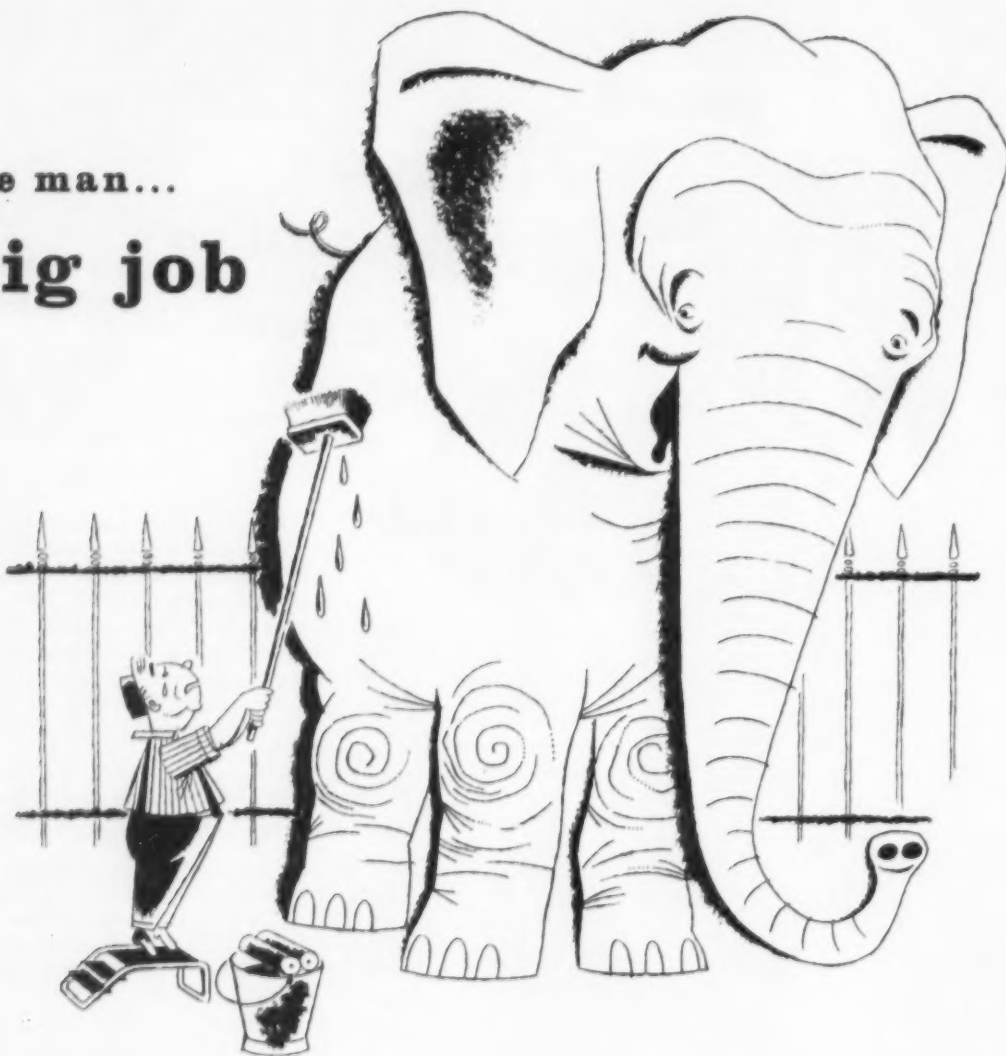
**BALING  
SYNTHETIC RUBBER**



DESIGNERS AND BUILDERS OF BETTER MACHINES AND PROCESSES FOR BETTER RUBBER AND PLASTICS PRODUCTS

Little man...

## Big job



This unhappy little man, with a too-short pole and a too-tall animal, no doubt is thinking, "Acres and acres of elephant, and he's all mine—to clean!"

Is your custom molder like the little man? Does he have to stretch his facilities and his staff w-a-a-y out in order to handle your molding jobs? If he does, brother, beware!—because, should the time come when, right in the middle of your job, he contracts to make 200,000 Whatzits for someone else—well, you know the sad, sad story.

Now, at Boonton (you knew we were

going to say this, didn't you?) here at Boonton it's a happier story. First of all, our plant is so chockful of fine, modern compression and injection molding equipment, you'll have to squeeze through the door to get in. Also, our technical men have more than 34 years' experience at scheduling jobs so they're completed right on time.

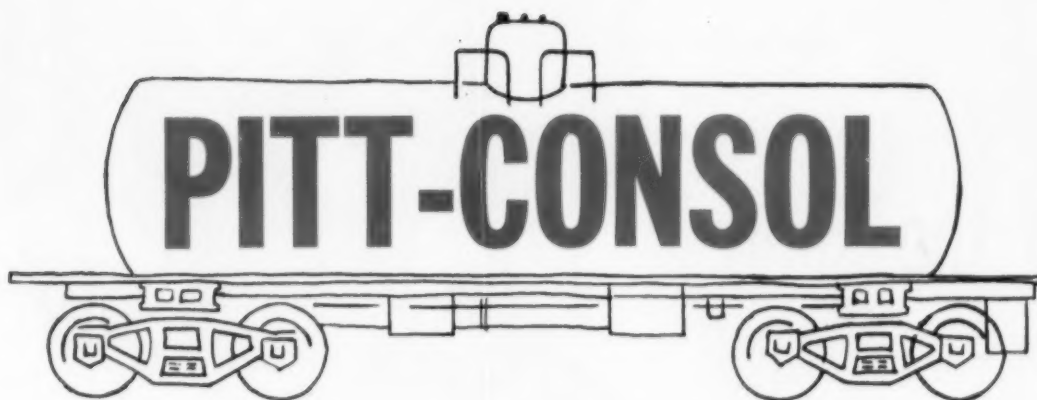
The main point, though, is our motto that a customer in our plant is worth two contracts on the bush. You'll always get *all* our attention, *all* through the job—and the price will be right, too.



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off the shelf  
and



## hard at WORK

The majority of the material in the Modern Plastics Encyclopedia Issue is *work* data . . . information which most companies utilizing plastics can put to practical use, day-in and day-out.

This 1,006-page volume gives complete coverage to such important subjects as the characteristics of plastics materials, and the employment of fillers for lowering the cost and increasing the strength of plastics parts. Plastic coatings and foamed plastics are discussed exhaustively, as are all important finishing and decorating methods. Of course, the new cost-reducing slants on vacuum forming, deep drawing, injection molding, extruding and other production techniques are explained, too.

Countless hours of hunting for sources for resins, machinery, equipment and custom services such as molding, fabricating and decorating can be saved by referring to the world-famous Directory Section. It is thoroughly indexed for fast reference. The many ads also help lead you to qualified suppliers.

On the shelf your Modern Plastics Encyclopedia does you no good; at *work* it can be one of your most valuable production tools. Use it often!

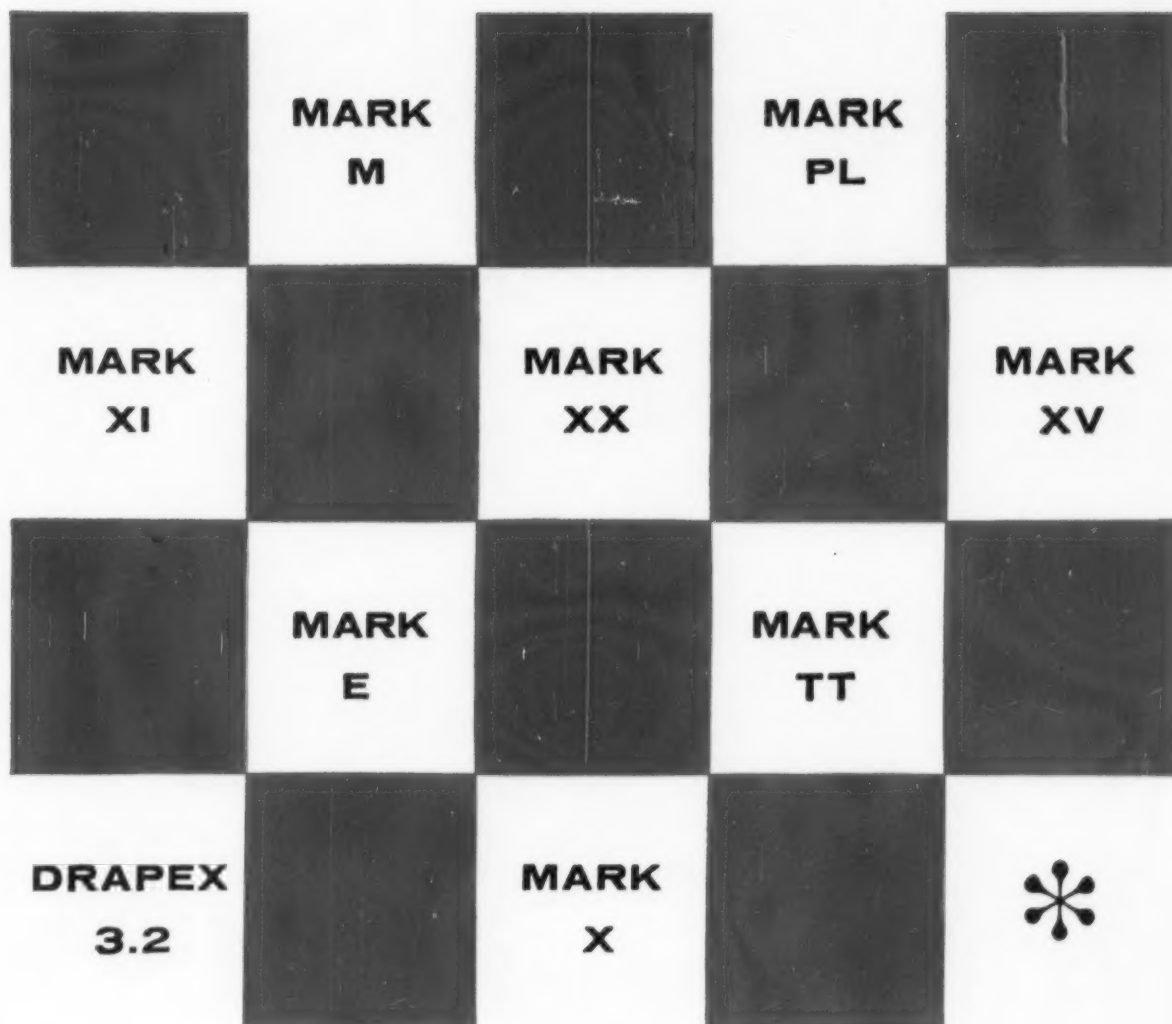
### Don't Overlook the Helpful Plastics Charts

Nine important charts summarize technical data on plastics films, adhesives, coatings, laminates, plasticizers and other vital topics. The plastics properties chart, perhaps the most referred-to section of the Encyclopedia, measures 45" x 28" and is suitable for wall mounting.

## MODERN PLASTICS

A Breskin Publication

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There is an Argus stabilizer to meet every requirement. For help with any specific problem, our research department is at your service.  
Send for Technical Bulletin No. 156

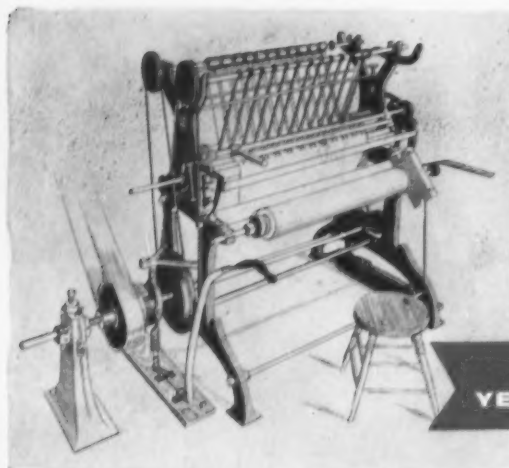


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# A Sound Investment

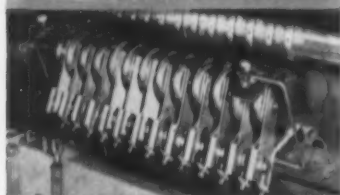
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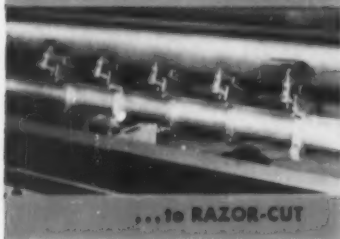
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...from SCORE-CUT



...to SHEAR-CUT



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**500**

**Every Camachine** ever built has been a *sound investment* for the user . . . ahead of its time in productive capacity . . . in economy and ease of operation . . . in quality of output. Now, as another *sound investment*, the modern Camachine 500 speaks for itself . . .

Here, in one machine, is the ability to handle an extraordinary range of materials, including light, heavy, stretchy or rigid plastic films; laminates of all types; waxed or coated papers; kraft; foil; impregnated fabrics; and other roll products.

The exceptional productive capacity of the new 500 is provided by (1) quick changeover from one slitting method to another, including score-cut; shear-cut; razor-cut; or SEALCUT® for fusing; and (2) ultra-sensitive automatic rewind density control which assures exactly the degree of softness or hardness you need without stretching, snap-off or slack while running.

Camachine 500 specifications include trim widths up to 72"; finished rolls up to 20" dia., speeds to 2000 fpm. Speed is dependent on machine width and character of materials. Write for Bulletin 1050.

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# CAN ALPHA'S DIFFERENCE MAKE A DIFFERENCE FOR YOU?

New monomer now available for evaluation

Now produced commercially by Hercules at its new oxychemicals plant at Gibbstown, New Jersey, *alpha*-methylstyrene provides a challenge to chemists who are looking for a lower priced material with many of styrene's advantages plus numerous unique properties of its own.

Hercules *alpha*-methylstyrene is an unsaturated hydrocarbon, derived from propylene and benzene, that boils at about 165°C. It copolymerizes with other monomers such as styrene, butadiene, divinylbenzene, and

acrylonitrile. *Alpha*-methylstyrene does not polymerize alone readily by a free radical mechanism. This results in increased storage stability.

It can, however, serve as a reaction modifier when used as a partial replacement for styrene in many of the latter's uses. Such uses include GR-S rubber, styrene-butadiene latices, styrenated drying oils,

styrenated alkyds, and polyesters.

Low molecular weight polymers of *alpha*-methylstyrene have been found useful as low-cost plasticizers for such items as hot-melt resins and wire coating.

Hercules will be glad to send you a generous sample for testing, and subsequently to cooperate with you in working on specific applications.

Oxychemicals Division, Naval Stores Department  
**HERCULES POWDER COMPANY**

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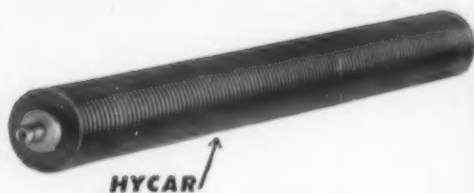


NPDS-3

*Another development using*

# **B. F. Goodrich Chemical** *raw materials*

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ideas in the  
five o'clock  
mail*



*Roller made by the Ames Rubber Company, Hamburg, N. J., for the Hoyer Corporation, Chicago, Ill. B. F. Goodrich Chemical Company supplies only the Hycar rubber.*

**I**T'S four p.m. in your office . . . the phone rings. It's a report of a fast-breaking business situation—information you'd like to get into the hands of 300 distributors first thing in the morning. Can you do it?

You can, and Hycar helps turn the trick, with the efficient new spirit duplicator above. In an hour's time you can turn an idea into a full-fledged direct-mail campaign, complete with copy and illustrations in as many as five colors. Hair-line register and positive feed are achieved with a spirally-grooved

roll made from Hycar American rubber.

The designer specified Hycar for this important job because it keeps its shape and flexibility, resists wear, abrasion, and the deteriorating action of duplicating fluid. Hycar also resists lubricating oil, grease, and chemicals, maintains its unique physical properties over a wide range of temperatures.

Many parts and products owe their success to designers who know about the exceptional qualities of Hycar nitrile rubber. For complete

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## Resins UP a Billion Pounds!

**P**LASTICS and synthetic resins sales went through the roof like a charge of dynamite in 1955. The much sought-for goal of three billion lb. was left far behind as all major resins exceeded past records for a total of somewhere near three and a half billion pounds. When the final record is written, it will probably verify the estimate that 1955 sales exceeded 1954 by almost a billion lb.—an increase somewhere between 35 and 40 percent.

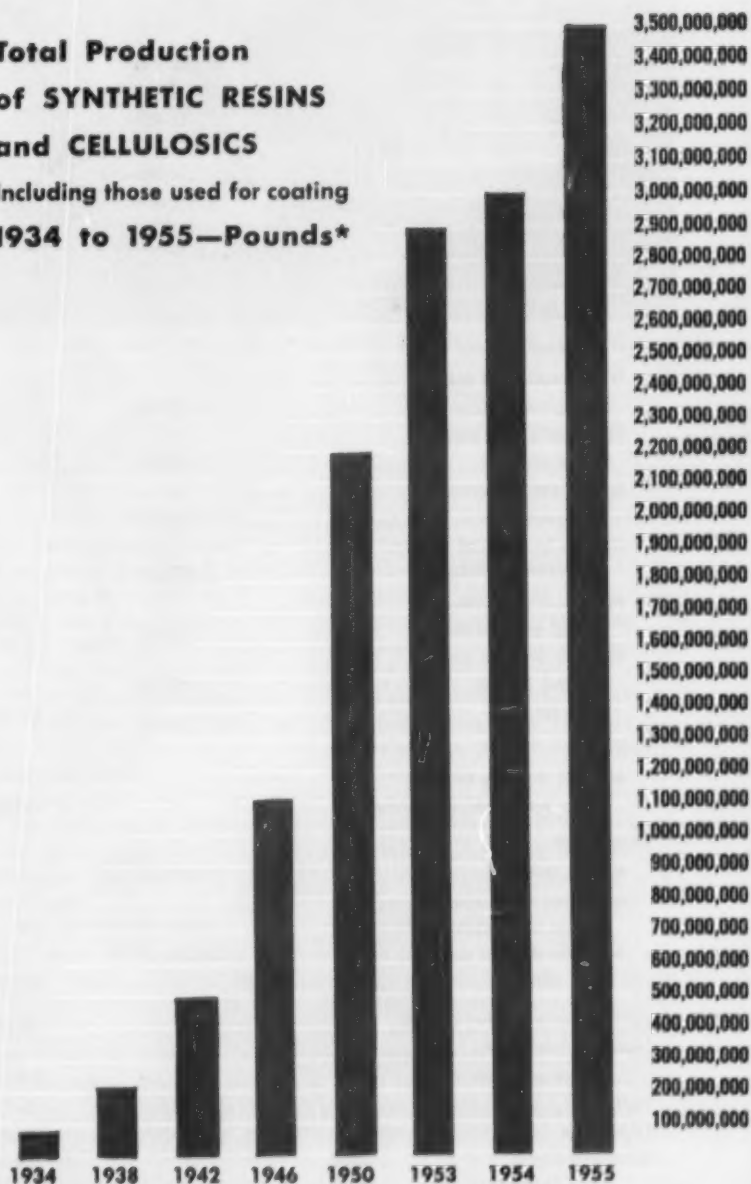
Vinyls led the procession with a total approaching 650 million pounds. About 500 million lb. of this total was vinyl chloride. Among plastics resins, the next in line was styrene resin followed by phenolics and polyethylene. The alkyd resins, which were second after vinyls, are not generally considered a part of the plastics industry—they stand on their own feet as the basis of a powerful paint industry that is a relation to, but not a member of, the plastics industry.

Outstanding features of this notable increase in plastics sales volume was the vinyl chloride jump from around 400 million lb. in 1954 to approximately 500 million lb. in 1955, and the polystyrene molding material increase to 375 million lb. from 309 million lb. in 1954.

Polyethylene was a star performer too, but not quite as astonishing because its growth was expected. However, there were few who would have believed a year ago that polyethylene would boom from around 200 million lb. in 1954 to over 350 million lb. in 1955. And the latter figure is considered a very conservative estimate—there are many in the industry who insist that the sales figure should be between 370 and 380 million pounds. A production estimate of 400 million lb. was recently given by a major producer.

Best testimonial to the potency of

**Total Production  
of SYNTHETIC RESINS  
and CELLULOSICS  
including those used for coating  
1934 to 1955—Pounds\***



\* Source: U.S. Tariff Commission and MODERN PLASTICS estimates.

**Table I—Sales in Pounds of Synthetic Resins and Cellulosics, Including Surface Coatings, in 1955<sup>a</sup>**

<b>Cellulose plastics</b>		
Cellulose acetate and mixed esters		
Sheets under 0.003 gage	18,000,000	
Sheets 0.003 gage and over	15,000,000	
All other sheets, rods, and tubes	7,500,000	
Molding and extrusion materials	87,000,000	
<b>TOTAL</b>		<b>127,500,000</b>
Nitrocellulose sheets, rods, and tubes		5,000,000
Other cellulose		6,000,000
<b>Phenolic and other tar-acid resins</b>		
Molding materials	200,000,000	
Laminating resins	70,000,000	
Abrasives	13,000,000	
Friction materials, brake linings, etc.	20,000,000	
Thermal insulation binder	43,000,000	
Plywood	36,000,000	
All other bonding resins	21,000,000	
Protective coatings	24,000,000	
Miscellaneous	32,000,000	
<b>TOTAL</b>		<b>459,000,000</b>
<b>Urea and melamine resins</b>		
Textile-treating and textile-coating resins	40,000,000	
Paper-treating and paper-coating resins	21,000,000	
Bonding and adhesive resins for plywood	88,000,000	
All other bonding and adhesive uses, including laminating	27,000,000	
Protective-coating resins, straight and modified	27,000,000	
Resins for all other uses, including molding	74,000,000	
<b>TOTAL</b>		<b>277,000,000</b>
<b>Vinyl resins</b>		
All types, including chloride, saran, butyral, polyvinyl acetate		450,000,000
<b>Styrene resins</b>		
Molding materials	375,000,000	
Protective-coating resins, straight and modified	90,000,000	
Resins for all other uses	70,000,000	
<b>TOTAL</b>		<b>535,000,000</b>
Alkyd and rosin modified coatings <sup>b</sup>		585,000,000
<b>Coumarone-indene and petroleum polymer resins</b>		
		780,000,000
Polyesters		57,000,000
Polyethylene		350,000,000
Miscellaneous types		140,000,000
<b>GRAND TOTAL</b>		<b>3,451,500,000</b>

<sup>a</sup> Source: U. S. Tariff Commission, first eight months, last four months estimated.

<sup>b</sup> Production figure used rather than sales figure since many paint plants produce their own resin.

the plastics industry as a consumer of chemicals—and a sure-fire indicator of its growth in 1955—was the parallel growth of those chemicals which contribute the raw material from which plastics are derived. Benzene grew from 240 million gal. in 1954 to about 300 million in 1955. Greatest production year ever before was 1951 with 260 million.

**Phenol** increased from 417 million lb. in 1954 to 500 million lb. in 1955. Phthalic anhydride consumption grew from 254 million lb. to 350 million pounds. Styrene monomer production was one billion lb. in 1955 as against 703 million lb. in 1954.

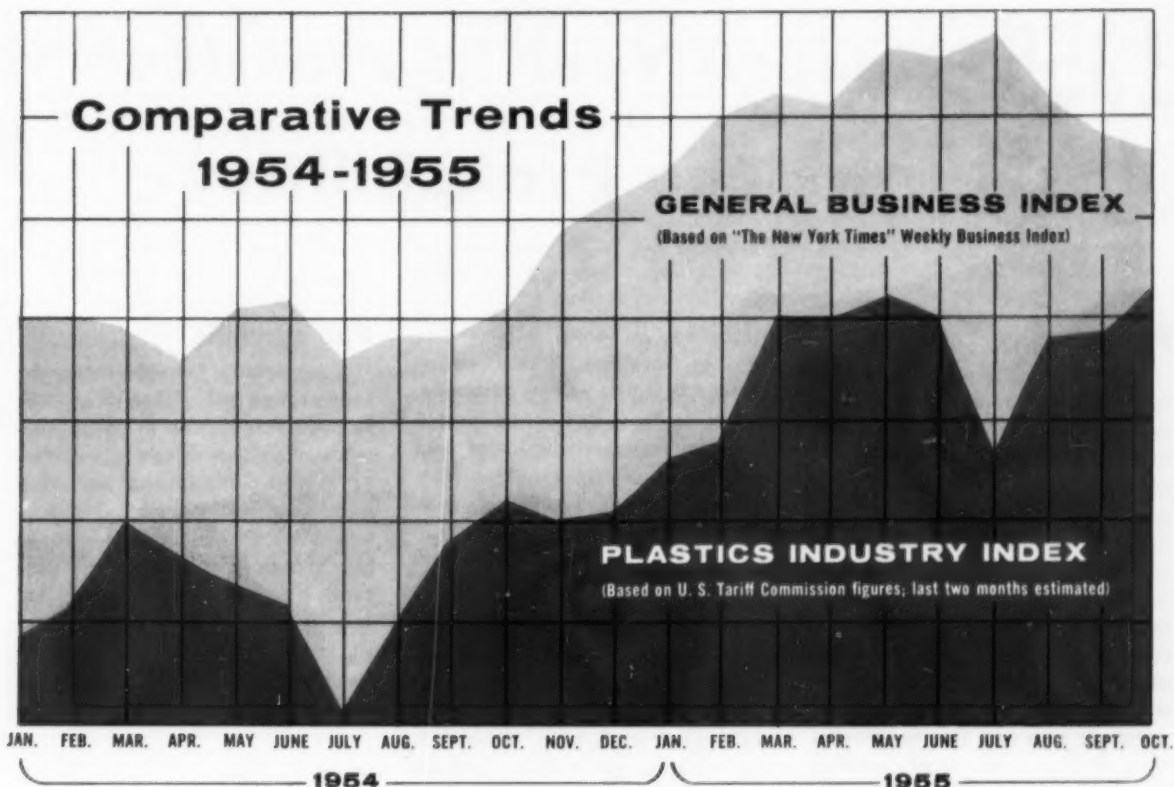
An unusual incident of the big plastics boom in 1955 was that there were very few really new applications. The growth came in general from an increase in applications that had been well established in the past. One veteran in the industry explains this situation as a consolidation of past gains before moving on to new ground.

No doubt a great part of the plastics increase was occasioned by the increase in automobile production and a continuation of the construction industry's boom that has been continuous since the Korean war.

**The automotive passenger car industry** may have consumed over 80 million lb. of plastics in 1955, including almost every kind of plastic known. There is no accurate record available of the amount of plastics used per car at present—some analysts think it is more than 10 lb. per car—others would go no higher than 8 pounds. The only certain knowledge is that the per-car use for plastics is growing each year.

**Construction industry** uses for plastics have various facets. Industrial and institutional buildings use vinyl for wire insulation as well as floor and wall coverings; phenolic and urea for plywood glue; phenolics, melamine, and urea for wiring devices and in bonding mineral insulation; and thousands of pounds of laminates. The more than one million houses constructed each year not only use more of the same things, but additional quantities for such things as draperies, kitchen equipment, and furniture. The furniture industry alone increased its production rate over 20% in 1955 and the percentage of plastics used in furniture is going up each year.

Still another unbelievably large



amount of plastics went into the **export market** last year—from 250 to 300 million pounds. How long this field will remain at such a figure is problematical. Plastics materials plants are being constructed all over the world in ever increasing quantity, and the time may soon come when their demand for imported plastics from the United States will begin to decline.

An old tradition of the plastics industry that business is always better in the second half of the year than in the first half was in danger of being upset again in 1955, but the answer won't be known until all the returns are in. In September hardly anyone would believe that second half sales could equal first half sales, because of the severe decline in July when sales are always down because of vacations and shut downs. But August rebounded better than usual and preliminary reports indicated that October sales would be greater than any month ever known in plastics history. Furthermore, November commitments were almost as high as October sales.

Now that the plastics industry is **reaching maturity** it is interesting to

compare its sales pattern with that of all business as shown in the graph on this page. In 1955, plastics followed all business quite closely until July which, as mentioned before, is vacation time in plasticland.

Plastics shows a much quicker upsurge in the last half than general business, which didn't start back up until October, after the summer decline and therefore doesn't show on the graph.

One unusual factor in the statistical summary of the year's happenings is the closeness of production and sales figures. In other years there has nearly always been a difference of several hundred million pounds. The MODERN PLASTICS estimate for sales will probably be higher than other estimates based on Tariff Commission reports because it uses the production figure as a sales figure for phenolic laminates and the alkyd and rosin modified coatings. The reason is that these materials are frequently used by the company that makes them and consequently are *not* reported in the sales figures. However, they are certainly "consumed" and it is the consumption figure that most

readers are concerned with. In all other classifications the resin used by captive plants is generally reported as sales, even though it is a bookkeeping transaction.

Other highlights of the industry in 1955 not reported above were the announcements of new polyethylene resins with higher heat resistance and greater stiffness; increasing use of vacuum formed sheet materials; the sudden jump of polyester resins for various applications from a 36 million-lb. volume in 1954 to over 55 million in 1955; the rather drastic price reduction in vinyl chloride resins; and the opening of six new polyethylene plants by six new producers.

Few plastics men are willing to go out on a limb for 1956 possibilities. In isolated cases they will predict a 10 or 15% increase, except for polyethylene which is expected to be much higher regardless of circumstances. Conditions seem to warrant optimism for the first six months—almost no one will go beyond that period. They are too busy taking care of present business to think about what is going to happen a year from now.

# 1955—Record Year in Plastics

## 1956—The Probabilities

### Phenolics

Phenolic molding powder made a remarkable comeback in 1955 to make up most of the loss suffered in 1954 even though few new applications were originated. New general-purpose, fast curing resins made good headway. High-pressure laminates had best year ever, sparked by increases in decorative laminates. Printed circuit bases look like big future market. All other types of phenolic resins made moderate increases with resins for plywood glue and thermal insulation in the lead. Shell molding resins remain as most promising, but big volume is two or three years away.

### Nylon

Substantial growth in 1955, but no accurate figures available. Nylon custom molders adopting proprietary items for parts business. New caprolactam type just getting started.

### Urea and Melamine

Molding material in 1955 enjoyed 12% increase over 1954.

Melamine dishware alone was 20% or more over 1954. Urea increased in major outlets—buttons, wiring devices, closures. Expect 5 to 10% increase of combined total in 1955. Urea glue benefited from increased plywood business.

### Acrylics

Molded methacrylates benefited from huge automotive market. Sheet continues to show gains in signs, glazing, lighting. Extrusion technique for sheeting is improving. Acrylate paint shows definite increase in volume. Acrylate for plasticizer and copolymer use is attracting more attention.

### Vinyl Chloride

Volume of sales grew from about 400 million lb. in 1954 to around 500 million in 1955. Wire covering and floor covering made largest gains, but there were big increases in every classification. Coated fabric won top approval in automotive industry. Film for laminating is among most promising of new developments. Increase in 1956 expected but in smaller percentage than 1955.

### Polyethylene

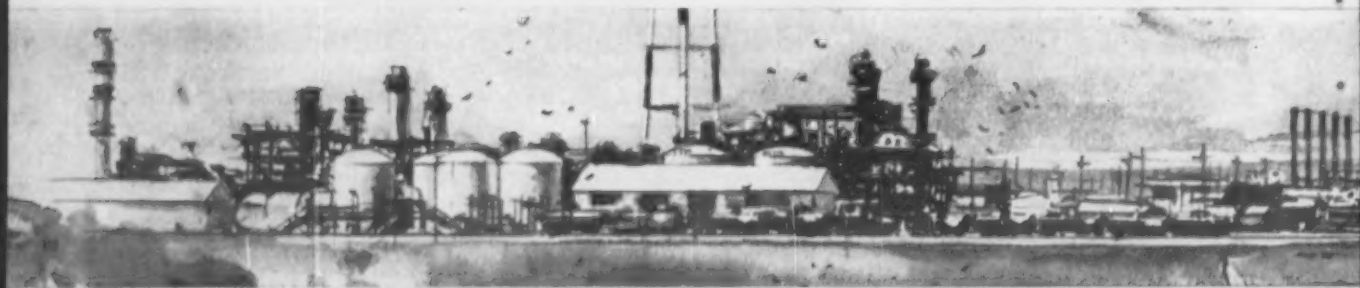
Sales volume for resin increased from around 200 million lb. in 1954 to over 350 million in 1955. Film sales almost doubled—grew from 70 to 130 million lb. or more. Six new producers started in 1955 or late 1954. Total capacity will be 600 million lb. by mid-1956—may reach a billion lb. before 1959. Announcement of new low-pressure polyethylene took industry by storm but there won't be much before 1957.

### Cellulosics

Molding material, film, and sheeting had biggest year on record—12% increase over 1954. Over 10 million lb. increase for molding material. Contour packaging holds immense promise for acetate. Expect at least 10% overall increase for cellulosics in 1956.

### Polystyrene

Molding material increased from 309 million lb. in 1954 to 375 million in 1955. High-impact material jumped from estimated 120 million lb. in 1954 to at least 175 in 1955. Refrigerator parts are by far the largest consumer.



## Phenolics

**H**OW long can an industry continue to grow without spreading its base of operations?

That was the chief question concerning the phenolic molding industry in *MODERN PLASTIC's* January 1955 review. As yet, no definite answer can be given. Sales increased from 172 million lb. in 1954 to an estimated 200 million lb. in 1955 (see Table II, p. 80), but phenolic was about the only plastic that did not break a sales record in 1955. The increase came from a greater demand by certain industries, such as electrical, where phenolics go into component parts. There was no broadening of the base—there was not even an across-the-board increase; phenolic volume declined in some applications where other materials moved in. There were no new applications that gave promise of developing into large-volume use, although it is possible that a new phenolic aerosol container may eventually qualify as such a product. A new phenolic part for a battery rack is another possibility.

It is quite possible that the phenolic industry may have reached a plateau, on which level it could continue for several years with only a slow growth in sales volume that would be based entirely on the growth of several industries which it now serves. This would indeed be something new, for past history indicates that phenolic molding powder sales fluctuate violently, depending upon the supply situation, development of new applications, and the nation's economic health.

**Increased Industrial Demand—**One encouraging feature is that the drop of around 30 million lb. of phenolic when television cabinets

were largely turned to other materials in 1953 and 1954 has been offset by increased demand from industrial sources where phenolic is an old-time standby. This could indicate that phenolics will grow only in proportion to the rate that all industry grows, which is ordinarily only a few percent per year. This is in contrast to most of the thermoplastics which are currently growing at rates of from 15 to over 30% a year. Since the phenolic industry is more mature than the thermoplastic industry, it should not be expected to grow as fast because it has been thoroughly inspected by prospective users long ere this late date. If they wanted to make something out of phenolic, most of them should know whether or not it will work by this time.

On the other hand, there are old timers in the industry who are still thrilled by the fascination of having watched the industry grow from a few million lb. annual production to a 200 million lb. giant within 25 years' time. They are loath to agree that growth is leveling off, and anticipate that new products made from phenolics will certainly appear in the future. Such products, they hope, will add to the base and thus guarantee a continuous rise in the volume production over the years.

This sort of thinking is partially based on a belief that phenolic prices will become more and more competitive with materials such as metals and wood, which have been on the rise while phenolic prices have been fairly well stabilized for a long time.

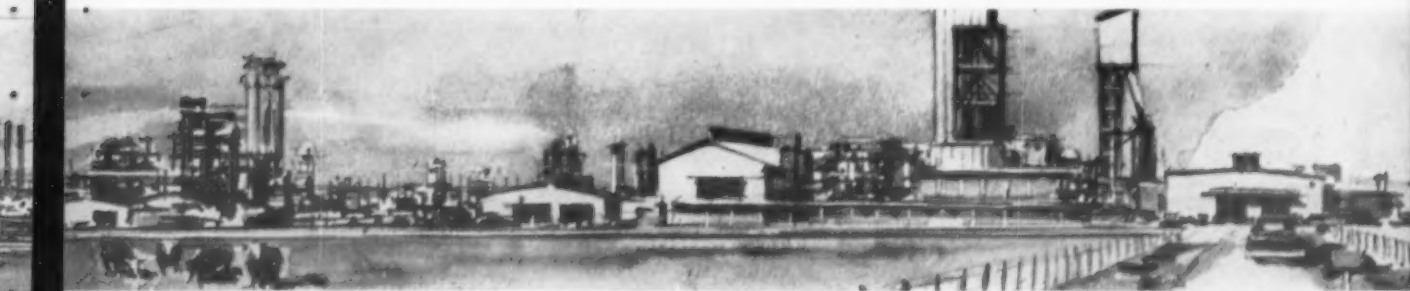
**Cost per Cubic Inch—**On the basis of weight and price, the cost per cubic inch of phenolic moldings competes favorably with most any other material. The old-line veterans say that such a situation is certain to result in wider use of phenolics. In the same breath, they

warn molders that loss of the television cabinet business to lower-cost competition is a warning that more research and pencil sharpening is needed before the industry can capitalize on this basic "weight and cost" advantage.

Confidence of the highest sort in the future of phenolic molding powder was voiced by Durez, a leader for many years, when it opened its new 60 to 70 million-lb. capacity plant in Kenton, Ohio, last summer. And a newcomer to the industry, Pitt-Consol Chemical Co., a subsidiary of Pittsburgh Consolidation Coal Co., expressed like confidence when it purchased the Newark phenolic resin plant from Reilly Tar & Chemical Corp. and announced that over three million dollars would be spent for renovation and for the initiation of a vigorous campaign to sell molding material. And confidence from still another angle was expressed by Hercules last summer when it opened a new cumene process plant with an annual capacity for 26 million lb. of phenol, among other chemicals. Hercules expects phenol consumption to grow from 400 million lb. in 1954 to 600 million in 1960 and to double every 10 years after that. From 60 to 70% of all phenol produced is used, and expected to continue to be used, in the phenolic resin business.

Phenolic molding powder volume sales have now hovered around or over the 200 million lb. figure in four different years—1950, 1951, 1953, and 1955. The '50 and '51 rises are generally attributed to the Korean War, those in '53 to the television upsurge, and those in '55 to a general rise in the national economy. How to stay up there and how to get to a 250 million-lb. peak is the question now foremost in the minds of industry executives.

**Capacity Overbuilt—**Capacity of suppliers to produce material is



## Phenolic Consumption by End Uses

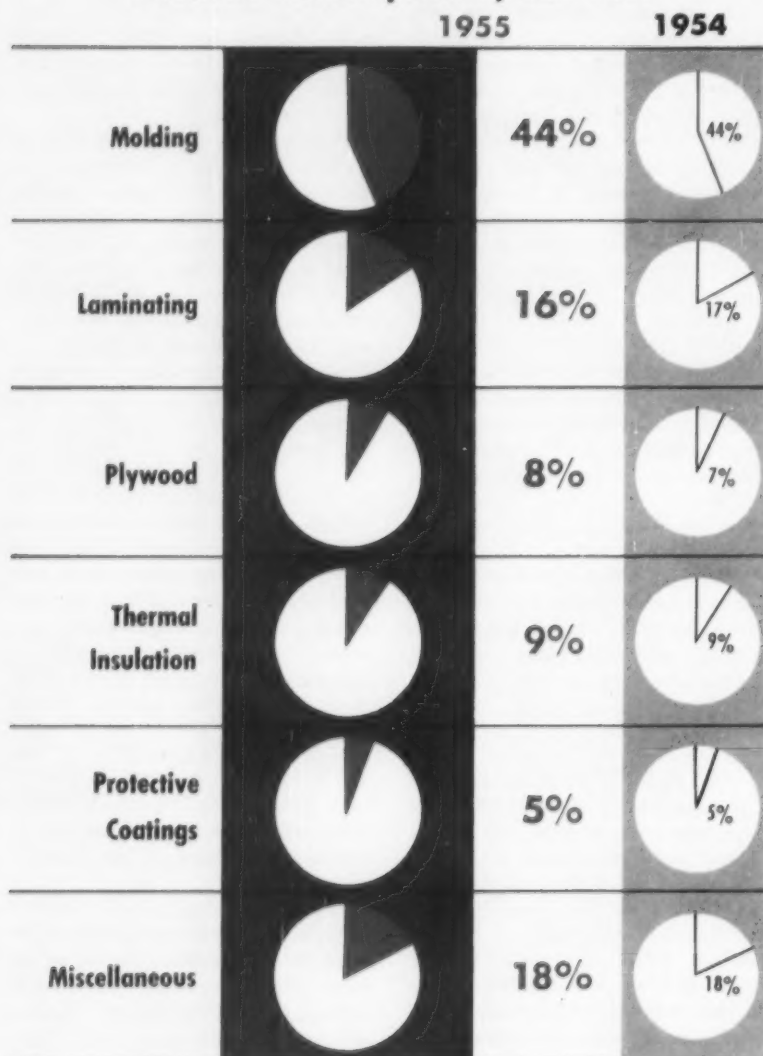


Table II—Phenolic Resin Sales<sup>a, b</sup>

Use	1955 lb.	1954 lb.	1953 lb.	1952 lb.
Molding materials	200,000,000	172,000,000	204,000,000	158,000,000
Laminating resins <sup>c</sup>	70,000,000	64,000,000	71,000,000	69,000,000
Abrasives	13,000,000	11,000,000	12,000,000	—
Friction materials, brake linings, etc.	20,000,000	15,000,000	16,000,000	—
Insulation for rock wool, fibrous glass	43,000,000	37,000,000	21,000,000	—
Plywood	36,000,000	28,000,000	34,000,000	40,000,000
All other bonding resins	21,000,000	13,000,000	18,000,000	—
Protective coatings	24,000,000	22,000,000	26,000,000	24,000,000
Miscellaneous <sup>d</sup>	32,000,000	27,000,000	28,000,000	61,000,000
<b>TOTAL</b>	<b>459,000,000</b>	<b>389,000,000</b>	<b>430,000,000</b>	<b>352,000,000</b>

<sup>a</sup> Source: U. S. Tariff Commission, except last 4 months of 1955, which is estimated.

<sup>b</sup> All on solid resin basis, except molding powders, which includes about half filler.

<sup>c</sup> Production figure used instead of sales figure because there are so many captive plants.

<sup>d</sup> Miscellaneous figure was not separated into various categories until 1953.

thought to be close to 400 million lb. and capacity of installed molding machines to handle this material is probably even greater. Obviously, the industry is overbuilt for current needs—yet molders were quite happy over last year's operations. They have never experienced more than one month with an over-20-million-lb.-volume anyhow, so when they managed to consume from 15 to 18 million lb. every month during 1955, except in July, most of them felt prosperous. There is a suspicion that the proprietary and captive molders may have been more prosperous in 1955 than custom molders, since they are particularly strong in the electrical field where phenolics had a very good year.

A highly-interesting speculation is just what would happen if the industry should suddenly develop a demand for 26 or 27 million lb. a month through the introduction of some new big-volume molded product. There is no question but that material would be available. The interest lies in how the molders would handle it. Such a demand would be a test of whether or not presently installed equipment is capable of turning out 30 or 35% more molded pieces than are now produced. Could the custom molders grab off a big share of this imaginary business or would the bulk of it go to captive plants? The phenolic industry may be older than its plastics cousins, but it is still just as full of imponderables, uncertainties, and hopeful futures as any other segment of the plastic field. Perhaps imagination is the property it lacks most in building for the future.

**Colors Possible**—Still another speculative realm is that concerning the development of a bright or pastel-colored phenolic resin. Producers have been working on it for years, and it is still a possibility. If such a material is ever made available, no one can say how many millions of pounds it will add to phenolic sales volume.

The year 1955 brought forth no startling new developments in either material or methods of handling. One thing the industry wants is greater speed in molding. Transfer molding, electronic preheating, and automatic presses have contributed immeasurably toward this end, but all of them were developed and blossomed forth in full flower

during and immediately following World War II. There are still many applications where neither preheating nor transfer molding is applicable. There has been no spectacular move toward faster molding in latter years from an equipment viewpoint, but suppliers are working on "fast-cure" resins. Some of these materials cut cure time by one-half—others by only 10 percent. Molders occasionally complain that they have too many rejects when using "fast-cure" resins; nevertheless, the new resins are considered to be one more step toward faster molding cycles, with great possibilities for the future.

**Automatic Molding**—The fastest growing area of the phenolic business at this time is in automatic molding of such items as wiring devices, closures, and even distributor caps. The impact of this trend may possibly have an even greater effect on volume sales in the future than it has in the past. Any molder who overlooks it may find himself obsolescent in a few years' time.

**Fillers**—Research in fillers continues apace, but nothing is yet in sight to replace wood flour for general-purpose molding material. High-impact and mineral-filled compounds are still employing essentially the same constituents as in former years. Glass-filled compounds are making headway, but are used only for a few special applications where specific properties are more important than cost. Chopped nylon-filled compound is now being offered and is expected

to broaden the base for impact compounds.

Phenolic-rubber compounds have not lived up to their original promise. Their cost of from 35 to 40¢ a lb., in contrast to 20¢ for general-purpose phenolic, has been a deterrent. Such products as knife racks and dishwasher parts are being molded, but large-volume use of this material cannot be foreseen in the near future.

The general trend in phenolic molding for the last three years is indicated in Table III, p. 82. Except for the increase in electrical control parts, all other increases were due primarily to increased demand for a product that used phenolic parts. The electrical parts field has been a constantly improving market for several years, and will probably continue to grow because of the particular fitness of phenolics for electrical applications. So far it has resisted all attempts at successful competition by other plastics. Wiring devices are in almost the same situation, although competition from urea and vinyl has taken some of the business.

**Handles**—Utensil and appliance handles look like a permanent market. Stability and resistance to heat are the desirable properties that phenolic materials bring to these applications.

The automotive increase is interesting, but is based largely on the phenomenal passenger car produc-

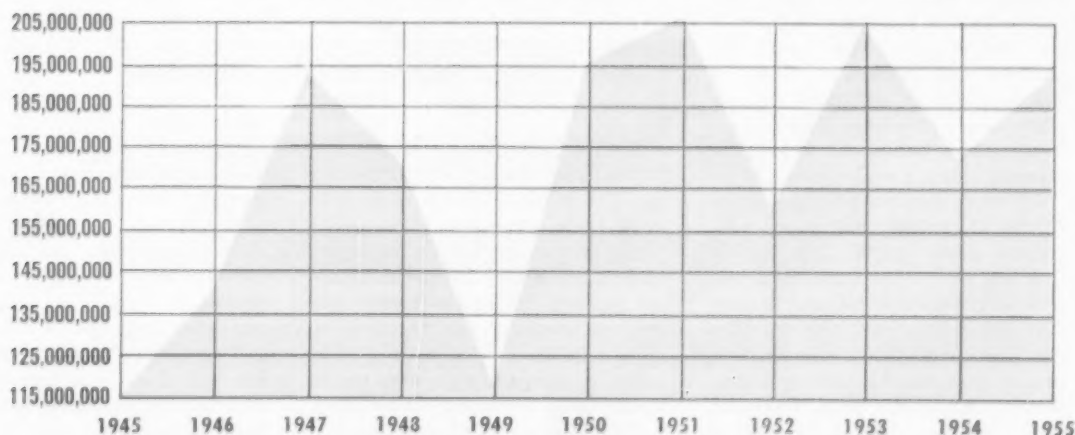
tion in 1955. Poundage has decreased per car over the years, but distributor caps, rotors, and coil forms are still made of phenolic, despite efforts to dislodge them. There is also a possibility that the development of a phenolic which can be chrome-treated may yet make its mark as a volume builder of considerable potential in the rapidly expanding automotive field.

The washing machine agitator business picked up in 1955 after a drop in 1954. A survey of 25 producers indicated that only two failed to use phenolics. Phenolics' resistance to detergents has become a highly important property for washing machines—it is an even stronger sales appeal than its resistance to common laundry soap since detergents are finding increasing use in washing machines.

The drop in phenolic housings was due primarily to the loss of television cabinets, but failure to find other housing applications has been a keen disappointment. There has been no big volume of production in furniture drawers and competition for this promising application is threatened by vacuum formed thermoplastics. The competition between molded phenolics, with their heat and abrasion resistance, and vacuum formed thermoplastics, with color and lower cost, puts the phenolics in a tough position. However, there is still reason to believe that the phenolics will eventually move into the

## ... a step toward faster molding cycles ...

### PHENOLIC MOLDING POWDER SALES IN POUNDS\*



\*Source: U. S. Tariff Commission, except last 4 months of 1955, which is estimated.

**Table III—Phenolic Molding Powder End Use Volume**

End Use	1955	1954	1953
	lb.	lb.	lb.
Electrical control parts (panel boards, switch gear, etc.)	51,000,000	39,000,000	38,000,000
Housings, including television	15,000,000	17,000,000	40,000,000
Wiring devices	30,000,000	26,000,000	28,000,000
Closures	15,000,000	15,000,000	18,000,000
Utensil and appliance handles	22,000,000	15,000,000	18,000,000
Telephones	4,000,000	5,000,000	6,000,000
Washing machines	13,000,000	10,000,000	12,000,000
Automotive	10,000,000	6,000,000	8,000,000
Vacuum tubes	6,000,000	5,000,000	6,000,000
Miscellaneous*	34,000,000	31,000,000	30,000,000
<b>TOTAL</b>	<b>200,000,000</b>	<b>169,000,000</b>	<b>204,000,000</b>

\* Miscellaneous includes such things as castor wheels; textile machinery; office equipment; buttons; camera parts; toilet seats; vaporizers; and exports.

NOTE: Figures above are all estimates; table is to be used only as an approximation to show trends.

furniture and large-housing fields in much greater volume than at present.

Other losses have occurred in the telephone and some of the miscellaneous fields, such as camera parts, where thermoplastics have moved in; but, again, such losses were more than compensated for in 1955 by increased volume in products that have been using phenolic as standard material for many years.

**Molding Powder Increase**—However, when an industry as big as the phenolic molding powder business shows a 15% increase, as it did in 1955, there can't be too much crying in one's beer over a decline in some of the markets. If phenolic can't be the king-pin in every market it enters, it can still be a potent contender in many. Researchers and marketeers are continuously seeking new outlets. Even though the industry has reached maturity, it still has youthful ambitions and expects to produce new offspring for many years before its productive capacity starts a real decline.

All other uses for phenolic resins (Table II, p. 80), had good, substantial gains in 1955. It could be that one or two of these uses will provide the greatest impetus to meet that huge future market which phenol producers seem convinced is certain to arrive by 1960 or thereabouts. All these uses increased about 18% over 1954 in contrast to the 15% increase for molding pow-

der. Another striking difference is that the statistics for all other than molding materials represent solid resin—the molding powder figure in Table II is about half resin and half filler.

**Abrasives**—The abrasives volume is one of the few that seems to have leveled off. Not much information is available from this field—it is a secretive, highly competitive market. Perhaps the figures given in Table II, p. 80, don't tell the whole story. It's difficult to believe that sandpaper and abrasive tool uses haven't grown any more than is indicated by these figures.

Use of resin for friction materials in brake linings received a big boost from the automotive industry, although the amount used per car is less than in other years since no clutch facing is used in automatic transmissions. But the brake linings are bigger and wear out faster because of the increased horsepower per car.

Resin for bonding rock wool and fibrous glass insulation is still growing. The greatest volume is for side walls, roofs, pipes, and with cement floors and roofs. Stoves and hot-water heaters take another substantial quantity. It has also moved into the automotive field for use as sound insulation in hoods, roofs, and doors. A comparatively new use is fibrous glass acoustical tile for office buildings with a vinyl or Mylar skin laminated to the mat. Future use of

resin binder for insulation should continue to grow in the next few years, provided the building industry stays at its present high rate of activity.

**Plywood**—Resin use for plywood (Table II, p. 80) needs explaining. Comparison with past years is unsatisfactory since all other phenolic adhesives were included in this classification before 1953.

The reason why the 1954 figure was low, was not only because the industry had price and labor troubles, but also because some of the companies which make their own resin were not reporting their resin volume to the Government.

The 1955 figure represents a plywood industry that was operating at capacity all year with few labor problems and with a fairly well stabilized price after a slight increase in June which met the new phenol price. There are apparently still one or two large plywood producers not reporting their resin consumption, but the 36 million-lb. figure is thought to be fairly representative. The number of mills producing plywood has grown from 42 to around 100—at least 12 were added in 1955.

The amount of exterior softwood plywood, the only type that uses phenolic, is probably less than 1/3 of the total softwood plywood produced. The ratio has not increased much during the 1950's. But phenolic glues are also used to some extent in hardwood plywood and in some of the so-called hardboards. The latter are growing nicely after several years of hesitation. Whether the resin used for paper surfacing on plywood is included in this plywood resin classification is not known, but volume of surfacing material is also showing a substantial growth trend.

The whole softwood plywood situation seems to be much more favorable than a few years ago when lumbermen were predicting a future shortage due to lack of peeler logs in the Douglas fir forests. Many of these same persons now say that the feared shortage is no longer a threat, thanks to improved reforestation and lumbering methods. They predict that the softwood plywood market will grow at a rate of 20% a year for an indefinite period, that the use of more phenolic-treated paper coatings will add to its useful-

ness for outdoor as well as indoor use, and that ever-increasing amounts of hardwood plywood will be used for doors and paneling. But they are also careful to point out that, although the softwood plywood industry will increase in sizable volume, the ratio between exterior and interior is not likely to change. Consequently, they look for only a conservative increase in the use of phenolic plywood glue.

Figures on the amount of phenolic resin used for hardwood plywood were not available at the time this article went to press, but this use is thought to be comparatively small. Phenolic resin is used in glueing veneers on boats and for other exterior applications—but there are only a few such applications in existence.

An interesting use of phenolic resin is in the production of patterns in the metalworking section of the automotive field. Mahogany veneer is impregnated with the resin and glued to a wooden core; this combination replaces solid mahogany which had a tendency to change dimensions. Volume of resin used isn't large compared to the grand total, but it's a good business for at least two companies and could become

## ... bonded wood waste has many possibilities ...

larger if applied to other types of patterns or "mock-ups."

**Wood Waste**—Other uses of phenolic resin with wood are scattered through several different classifications in Table II, p. 80. Probably most of it, other than that for plywood, is in "all other bonding resins." This should include waste wood, for which it is estimated that over 10 million lb. of resin were used in 1955. However, that figure includes both phenolic and urea, with the latter probably used in greater volume.

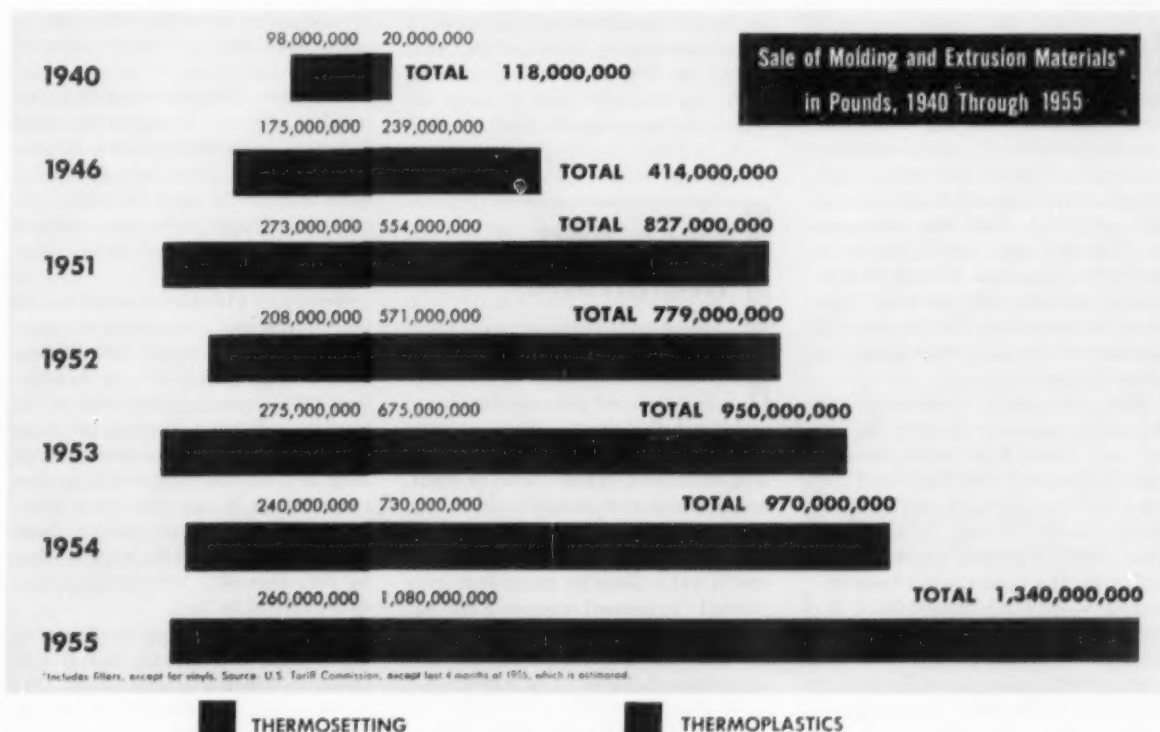
Chief product of this type now is probably hardboard—pressed panels of wood waste bonded with resin. It is used for partitions, drawer bottoms, interior paneling, and in veneers. At least ten processes for making panels of this type are now known. Only 2 to 5% resin is employed.

Good progress has been made in this field over the past two years, but it is still small. Hardboard is used almost entirely for interior work and not for structural purposes. Growth has been hampered because of some atrocious stuff that

came on the market early in the product's development. The usual unhappy customer relations developed after that rough beginning.

Structural uses of bonded waste wood probably will not be successful until at least 20% phenolic resin is used as the bonding medium. Lumber people say that this percentage of resin would make the board too expensive, but with so many of the leading lumber companies now working on this project it is logical to assume that they are going to improve their products, seek new markets, and produce a hardboard that will compete with other materials. A 20, 30, or 40 million-lb. resin volume for this purpose before 1965 seems reasonable because bonded wood has so many possibilities, but how much of that resin will be phenolic is problematical.

Still another use for bonding resins is in adhesives for other than plywood. Phenolic-butyral combinations are still among the best there are for printed circuits, for bonding metal, for some types of fabric such as used in body armor, and many



other purposes. Phenolic-rubber adhesives have been standard for a number of years in a whole host of applications. Folks don't talk much about adhesive formulations, but phenolics seem to be holding their own.

**Shell Molding**—There are many other relatively small uses for phenolic bonding resins, such as in lamp base cement, but the one expected to have the greatest future is in foundry core bonding and shell molding.

Shell molding received an inordinate amount of publicity when it was first announced back in 1951 as the next wonder-boy of the plastics industry. Growth has been very slow; it was never destined to become a giant over night, but shell molding is no longer a curiosity. It might be called a mature baby. People know what it is and they know how to use it. The next step is to in-

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## Phenolic Laminates

**T**HE LAMINATING division of the phenolic industry had an exceptionally fine year in 1955. There was some indication of a lag in decorative laminates in October, and November and December sales totals were not available when this article was prepared. But the consensus was that the year's total would be somewhere between 75 and 80 million lb. of solid resin used for high-pressure laminates. This represents somewhere around 160 million lb. of laminates.

The laminating industry has shown an amazing stability for the last two years. Ever since January 1954 the amount of resin used has been between 5 and 6 million lb. a month except for July when plants slow down to permit vacations. By and large, the industry has been operating with a substantial back log of orders throughout most of this period.

The 1955 increase included all kinds of laminates—industrial as well as decorative. The latter has

been a big factor in its contribution to the laminating industry's progress for several years, but industrials came back into prominence during 1955 after several years of doldrums.

**Growth of Decoratives**—The percentage of decorative laminates has grown steadily since World War II. Before 1950, it was estimated to have been less than 20% of the total. In 1954 the decorative portion was estimated at about 45% of all laminates. Estimates for 1955 vary from 45 to over 50%, depending upon who gives the estimate.

About one-third of the total weight of a decorative laminate is phenolic resin. From 8 to 10% is melamine used for the print sheet and overlay. The balance is reinforcement and varnish.

Uses for decorative laminates have now spread far beyond the original applications for table and kitchen cabinet or sink tops. They are now widely used in various kinds of furniture and construction paneling. Other materials such as metal and thermoplastics have made little if any dent in the laminates' conquest of the kitchen sink and cabinet markets. Housewives seem convinced that a "plastic" top is what they prefer for their kitchen furniture.

An interesting sidelight of the decorative business is that it has made big operators out of some of those who were quite small during

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## Urea and Melamine

**N**OT much new, but more of the same. That refrain, echoing all up and down the plastics front in 1955, was particularly applicable to urea and melamine. There was at least one striking new melamine molding—an aerosol container—but it had been anticipated back in 1954. No one is yet willing to guess how important the aerosol container will be from a volume standpoint. Produced by Colt as a 2-oz. container for Angelique Cologne, it is still a specialty job.

Whether or not this item will have

more widespread use as a container for pharmaceutical and more mundane contents is still a question. There are many types of aerosol containers on the market and more coming—some in other types of plastics. How much of the market the melamine job will get could only be guessed, but if beauty is any criterion, it will be a front rank contender. The melamine container reportedly costs about the same as vinyl-coated glass, or about 8¢ per unit. Metal aerosol containers cost about 5¢ in a 6-oz. size.

Table IV shows that urea and melamine molding and miscellaneous resins broke all previous records; in fact, they came close to what is generally considered the industry's capacity. No one seems to know exactly what is included in "all other uses," but it isn't deemed to be a significant portion of the whole.

The 74 million-lb. figure is considered a conservative estimate, but when it was made there was still some doubt about November and December. The September sales figure was about 7.8 million lb., or 35% over the same month in 1954. It was approximately the same as April and May. October probably exceeded that figure to become a record-making month for urea and melamine molding material sales. The first six months' sales were 38 million lb. in comparison with 31 million lb. in 1954.

**Dishware**—Melamine molding material is still on the upswing, with dishware contributing the largest volume. Total poundage for dishware must be at least 18 million lb. or more. Other melamine molding materials are estimated at less than 5 million pounds.

Melamine dishware should be on the increase for some years to come. There are now about 20 molders compared with only four or five before 1950. Approximately 60% of all present melamine dinnerware sales are in the institutional market and only 16% of the restaurants in this country use it. As one sales manager said: "Sixty percent of them could be had." And he expects that by 1960 that 60%, or a good portion of them, will be had.

Quality melamine costs about one third more than china, but it will stand an average of more than 1400 servings without showing an undue amount of stain if it is submitted to

a once-a-week hand wash. Only 900 servings can be expected from china before it becomes useless.

The recently announced method of decorating melamine tableware with colorful patterns applied during the molding process is another advantage for melamine that makes it even more acceptable for home use and comparable to chinaware.

The big million-lb. Army orders that helped start melamine dishware on its way to fame have now tapered off to mere replacement orders, but the Marines are still ordering in volume. Various experiments with different types of fillers are being tried out for the Armed Services, where there is still some reluctance to accept the standard filled material.

**Buttons**—Melamine buttons are gradually taking over a larger portion of the market. Urea and pearl are still more common, but one of the largest shirt makers uses melamine exclusively on a line of comparatively low-priced shirts. Melamine is also generally used for buttons on sports shirts. The polyester buttons, which are machined from rod, have grown rather slowly.

Melamine for use in high-pressure decorative laminates was treated in the section on Phenolic Laminates. It has grown from a few million pounds before 1950 to a sizable 10 or 12 million lb. in 1955. The only discomforting factor is that it takes such a small amount of melamine to do a really big job.

**Molded Urea**—The usual pattern of urea molded products continues, with closures, buttons, and wiring devices as the principal products. Urea closures had their biggest year in 1955 and cosmetic containers grew with them. More volume went into radio cabinets, clock cases, and cabinets than in previous years, but there were no outstanding new additions to the field. The promise that toilet seats might develop into greater volume in 1955 is still a promise, but nothing more.

The low-cost ureas in dark colors continued in the background, but there is a possibility that something may pop in 1956.

**Glue**—Urea glue for plywood made a remarkable advance in 1955. Glue prices stabilized somewhat in 1955, but it is still a low-profit industry. It is used almost entirely in hardwood plywood because it can't

Use	1955	1954	1953
	lb.	lb.	lb.
Textile treating and textile coating resins	40,000,000	39,000,000	35,000,000
Paper treating and paper coating	21,000,000	20,000,000	22,000,000
Bonding and adhesive resins for: Plywood	58,000,000	75,000,000	51,000,000
All other bonding and adhesive uses <sup>b</sup>	27,000,000	24,000,000	43,000,000
Protective coating resins, straight and modified	27,000,000	22,000,000	23,000,000
Resins for all other uses, including molding <sup>c</sup>	74,000,000	66,000,000	65,000,000
<b>TOTAL</b>	<b>277,000,000</b>	<b>246,000,000</b>	<b>239,000,000</b>

<sup>a</sup>Source: U. S. Tariff Commission, except last 4 months of 1955, which is estimated.  
<sup>b</sup>This figure includes resin used for waste-wood bonding and melamine laminates, as well as commercial glues.  
<sup>c</sup>Includes filler for molding material.

compete with soya glue in softwood plywood for interior use. The latter cold-sets in 15 min.; if urea were used in this process, it would require 4 hr. to set. The hardwood plywood that employs urea is used primarily for furniture, doors and paneling, and packing cases. The latter is a declining market because of competition from paperboard. Another disturbing element is the increasing amount of hardwood plywood imported from Japan and Africa. It is claimed that 1 out of every 3 sq. ft. of hardwood plywood now used in the United States is imported; a few years ago the figure was only 1 out of 12.

Use of urea as a bonding agent for waste wood is on the increase, but again this is a case of a little that does a lot: the finished product contains only 2 to 3% resin. Urea is used to bond particle board—chips, shavings, and sawdust pressed into a solid board. It is used primarily in the eastern United States for furniture veneer, decorative laminate cores, and paneling. If used for structural parts, it must contain at least 20% resin and producers have not yet accepted that principle.

Over 10 million lb. of urea and

phenolic resin are now used for this type of wood waste bonding and that means a mighty big wood pile of what was once chips and sawdust. This application just has to be a real big consumer of resin at some future date, but unfortunately, that date seems to be far in the future. Because of past disappointments, it just isn't safe to say that this promising market will double in the next three or four years, yet 25 or 50 years from now this product may be as common as any other lumber.

Other uses for melamine and urea resins grew in step with the rise in all other industry. The textile and paper-treating resins have grown more slowly than expected, but optimism about their future continues.

## Cellulosics

**L**IKE the metals, which run the gamut from aluminum to zirconium, there are plastics from acetate to zein. Curiously enough, the two plastics at the ends of the alphabet are among the very few that are not

derived from carbon chemicals. In a manner of speaking, they are vegetarians—or at least agricultural—since acetate is derived from cotton or wood and zein is dependent upon corn.

That fact is quite important, too, since the raw materials needed for cellulose acetate are more costly to obtain than the hydrocarbon chemicals used for the big-volume plastics with which acetate must generally compete. If cellulose acetate were as low in cost as most other thermoplastics, the statistics of the plastics industry would undoubtedly show a somewhat different distribution pattern.

**Best Year Yet**—The year 1955 was the best ever recorded for sales of cellulose acetate and butyrate molding and extrusion material. The best previous year was 1946 when 83 million lb. were sold—the second best was 1950, with 80 million pounds. The total of molding and extrusion material, plus sheet and film, was

also a record in 1955—13% over 1953, the previous top volume year for all cellulose esters used in the plastics industry.

Butyrate is estimated to have accounted for from 40 to 45% of the molding and extrusion market. Automobile steering wheels, telephones, and pens and pencils were large consumers. Butyrate pipe was estimated at a volume of from 3 to 4 million lb. in 1955—not much, if any, increase over 1954. Customers are testing out what they already have in use and extruders are experimenting with other materials for pipe.

**Molding Material**—Cellulose acetate molding material is moving along in increasing volume, no doubt stimulated by the lower cost of opaque, colored material which Celanese introduced several years ago. This material, or Group III, sells for 35¢ a lb. in comparison with Group II translucent at 46¢ and Group I clear at 50 cents.

Another explanation for increased acetate volume was the continuing boom in the toy industry that started in 1954. Molders crossed their fingers during early 1955 when toy orders kept piling up. They feared that the market would be saturated and that the fall season business would drop off; but the boom held up all year long. Acetate also won back a good share of the business that had been lost to other thermoplastics in previous years. Toy makers like the toughness inherent in acetate.

Dolls alone are thought to have required about 5 million lb. of acetate in 1955. Dolls were once molded chiefly from butyrate, but when a lacquer was developed for acetate that was unaffected by the plasticizer, acetate won the job because of price. Vinyl plastisols moved in on some of the doll business, heads especially, since a new method of applying the hair, strand by strand instead of on a wig, worked out more satisfactorily with vinyl.

Another good outlet was beads. The popularity of rope chain beads and a style fad calling for increased use of beads on dresses and hats was good for acetate. Most of the beads are made from Group II or translucent acetate. Beads, jewelry, and hair ornaments have been a good, steady market for years. They consume from 6 to 10 million lb. of acetate annually.

**New Materials**—One new material and one revived material came into the cellulose market in 1955. Herocel-W is a new, high-acetyl acetate that has been made more easily moldable than the older high acetyls. A different plasticizer is at least part of the answer. Herocel-W has a heat distortion temperature of 225° F. and low moisture sensitivity. It has good dimensional stability even under load in hot, humid atmospheres. It has been particularly successful when used as cutlery handles because it stands up against rough dishwashing treatment in automatic washers. Other possibilities are in housings, pens and pencils, combs, brush handles, radios, and oil containers, according to Hercules Powder Co., the producer.

The revived material is Celanese's cellulose propionate or Forticel. It was first introduced shortly after World War II, but was withdrawn from the market when the necessary

**Growth of Products Using Plastics in Large Quantities**

(Figures Given are Either Production or Sales, as Noted)

Products	1946	1951	1954	1955 (Est.)
Air conditioners (retail sales)	30,000	237,500	1,230,000	1,300,000
Floor-type vacuum cleaners (retail sales)	2,289,000	2,729,100	2,650,000	3,200,000
Television sets (production)	7,000	5,384,800	7,346,000	8,800,000
Refrigerators (retail sales)	2,100,000	4,075,000	3,593,000	4,000,000
Radios:				
Home (retail sales)		6,751,400	3,140,000	3,100,000
Portable (retail sales)	14,031,000	1,332,990	1,525,000	2,000,000
Clock (retail sales)		777,155	1,750,000	2,100,000
Washing machines (retail sales)	2,124,000	3,384,700	3,610,400	4,000,000
Automobiles (factory sales)	2,148,699	5,336,935	5,352,353	7,800,000
Trucks and buses (factory sales)	940,851	1,428,328	843,450	1,100,000
Dwelling units (Non-farm)	671,000	1,091,300	1,220,400	1,100,000

raw materials became difficult to obtain. Celanese now has a guaranteed source of supply from its own organization. The company has its own flake, produces propionic acid in Pampa, Texas, and has plasticizers not before available.

Full-scale production of Forticel started in December. It is a more stable material than straight acetate, contains only a small amount of plasticizer, has no odor, weathers well, and is particularly notable for its sparkling finish. Pen and pencil producers have been asking for it ever since it was taken off the market. It is aimed at about the same markets as butyrate. The intention is to bring it out in film and sheet form at a later date.

**Three Acetates**—There are now three types of acetate competing for the uppercrust acetate market. Hercocel-W at 55¢ a lb., Forticel at 62¢, and cellulose acetate butyrate at 62 cents. The total de-luxe market, including steering wheel handles and telephones, seems to be somewhere in the 35 to 50 million-lb. range. It will be interesting to see whether or not the press of competition will broaden that market.

**Ethyl Cellulose**—Another cellulosic, ethyl cellulose, is also a candidate for some of that same market, but its price is 72¢ per pound. The figure for ethyl cellulose in Table V, right, is largely guesswork. Some 12 to 15 million lb. of flake were produced in this country in 1955. A great portion of the flake is used for phonograph records, lacquer, and strip coat material. Another quantity is sold to a processor who uses it for film. The Armed Forces use a considerable amount for flashlights, radios, rocket parts, and other items. There are still several promising commercial items undergoing tests, but the users are still keeping their secrets under their hats until they can either get a jump on the market or make sure that ethyl cellulose is the best possible material for the job.

**Acetate Film**—The acetate film market was in a flourishing condition all year long. Orders were running weeks behind from January through December. Celanese will have a new cast film plant in January. Eastman Kodak added a second extruder for film extrusion. Both machines are now reported to be working almost exclusively on

## Consumption of Cellulose Plastics

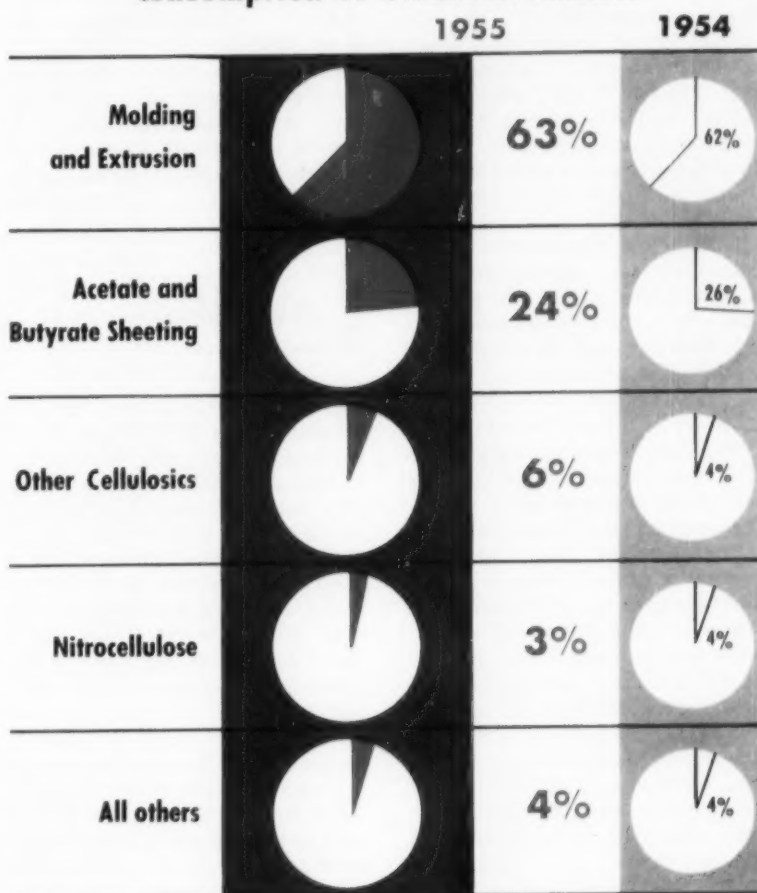


Table V—Cellulose Plastics Sales, 1952-1955<sup>a, b</sup>

Classification	1955 lb.	1954 lb.	1953 lb.	1952 lb.
Cellulose acetate and cellulose acetate butyrate sheets:				
under 0.003 gage	18,000,000	17,500,000	17,200,000	11,400,000
0.003 gage and over	15,000,000	12,400,000	13,100,000	9,800,000
All other sheets, rods, tubes	7,500,000	5,300,000	5,200,000	5,000,000
Molding and extrusion materials	87,000,000	75,500,000	77,000,000	58,600,000
<b>TOTAL</b>	<b>127,000,000</b>	<b>110,700,000</b>	<b>112,500,000</b>	<b>84,800,000</b>
Nitrocellulose:				
sheets, rods, tubes	5,000,000	4,900,000	6,500,000	5,500,000
Other cellulose plastics, primarily ethyl cellulose	6,000,000	5,000,000	6,400,000	6,500,000

<sup>a</sup>Source: U. S. Tariff Commission, except last 4 months of 1955, which is estimated.

<sup>b</sup>Includes plasticizers, fillers, and extenders.

butyrate film. Vacuum forming is largely responsible for the increased use of acetate film. There is actually reason to wonder why the increase in 1955 wasn't even greater than the figures in Table V, p. 87, indicate, taking into account the advent of blister and skin packaging which has taken the retail trade by storm.

Most of the film under 3 mils is cast. Customers seem to prefer it over extruded film in this thinnest gage. About 10% is extruded. The extruded film costs less and, when vacuum formed, the surface imperfections are not noticeable. Less than half of the under-3-mil film is used for packaging. The biggest portion is for tape, most of which is used in the electrical, sound-recording, and adhesive industries.

The over-3-mil film is both cast and extruded in continuous lengths and in widths up to 20 inches. Extruded sheeting is gradually obtaining a greater share of the market—it is obtainable in thicknesses up to 0.250 gage, or 1/4 inch. The continuous over-3-in. material is used for a multitude of applications—sequins, packaging, containers, billfold cases, envelopes, menu covers, ticket holders, office machine cards, laminating, and others.

**Over 20 Mils**—The "sheets, rods, and tubes" classification covers mostly material over 20 mils thick, but also includes thinner-gage material when sold in sheet form. Playing cards, for example, are produced from 10-mil stock.

This classification showed the largest percentage gain of any film or sheet grade in 1955. The reason was an increase in the optical industry where it moved in on the spectacle frame business and also in vacuum forming. Former uses, such as lamp shades, laminated identification cards, containers, etc., also moved ahead to follow the all-over business expansion. Vacuum formed parts from this heavier-gage material, aside from packaging, included embossed lamp shades, toys such as firemen's hats and games, display signs, and bottles.

**Contour Packaging**—The impact of self-service and rack counter sales on acetate film in particular and on vacuum forming in general

is one of the liveliest current episodes in the plastics industry. The Sears, Roebuck initiation of contour or blister packaging is being copied by every packager who needs visibility for his package or wants to display a combination item such as hinges and screws together. Lock-  
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## Acrylics

**M**ETHYL methacrylate was for many years the only member of the acrylic family that received attention from the plastics industry. It is still the principal member so far as molders and sheet fabricators are concerned, but the acrylates and acrylonitrile can no longer be ignored. Any plastics news medium that overlooked their significance would be missing important factors that influence segments of the plastics industry.

Acrylonitrile (vinyl cyanide) is used as a comonomer with styrene and vinyl chloride. It is an ingredient of nitrile rubber, which is used as a modifying agent with various resin formulations. It is the base for fabric used as backing, reinforcement, and filler materials for plastics. And B. F. Goodrich Chemical Co. has just announced that it is one of the base materials for a new textile, with the possibility that a series of resins for plastics may some day be developed from the same base. However, volume use of acrylonitrile in plastics is comparatively small.

Acrylates have been used for several years in coatings, finishes, adhesives, paint, and as viscosity regulators in oil. They are now coming into prominence as resins for paint bases. They have future possibilities as copolymers and plasticizers.

**Molding and Sheets**—Methacrylate resins for molding and sheet increased in volume just as other plastics did in 1955. No consumption figures are available. Methacrylates are listed in the Tariff Commission reports under miscellaneous plastics, along with various other resins. The only comment obtainable from raw material companies which produce

it is that the 50 to 60 million-lb. figure frequently used to represent consumption in 1955 is too high. The last most reliable estimate was that over 30 million lb. were used for molding applications in 1952.

Methacrylate molding powder use must have grown considerably in 1955 if for no other reason than its applications in automobiles. There were more and bigger parts per car. If 8 million cars were built in 1955, then somewhere between 11 and 14 million lb. of methacrylate must have been used for tail lights lenses, medallions, and similar parts. The figure might even be higher: estimates on the average amount per car vary, according to the viewpoint of the estimator.

**Traditional Uses**—There were no new outlets reported for methacrylate molding material in 1955—just an increase in traditional molded parts such as brush backs, jewelry, and medallions for refrigerators or other appliances. Molded lenses for directional light diffusers that contain four squares in a long pan-type fixture made some progress, but volume is still small. Attempts to get more molded material into the outdoor sign and letters market were not overly successful. Sheet proved more practical. Not only was fabrication from sheet more practical from a handling standpoint, but the market did not seem large enough to support the cost of expensive molds for use in injection machines.

Since cost of methacrylate molding and extrusion material is higher than that of most thermoplastics, its use is limited to those applications where its properties are such that no other material can compete—outdoor weathering and clarity, for example. Cost has been slightly reduced since 1947 when it was 70¢ a pound; by 1954 the price had been reduced to 68¢ f.o.b.; in 1955 the price was further reduced to 65¢ delivered. It can be obtained at 1/2¢ a lb. less if the customer can handle it in 1000-lb. containers. And future price trends will probably be downward.

**Volume for Extrusion**—Extruded methacrylate is expected to gain volume over the next few years. Great efforts have been made to improve extruding techniques for methacrylate. The goal is to reduce the cost for extruded sheet. One of the classical problems in extruded

methacrylate sheet has always been dimensional control. The sheet would shrink considerably, even in thickness, after extrusion. In addition to process improvements contributed by extruders and others, Du Pont has now developed a process which it believes will practically eliminate this shrink problem.

The methacrylate cast sheet situation is split into two sections—military and civilian. Large portions of the highest grade cast sheeting have always gone into military airplanes and other applications where surface and clarity are of utmost importance. That market has not changed much over the years and requires a substantial part of all the sheet produced. Many attempts have been made to steal it from methacrylate, but there has been no substantial "steal" to date.

A new material, polymethyl alpha-chloroacrylate, produced by General Aniline & Film Corp. and called Gafite, is now available in experimental quantities and is intended eventually to capture a part of the military market. Its high-temperature resistance is desirable because of the heat developed in flight at supersonic speed. However, Gafite is generally considered as too costly a material for civilian applications.

**Low-Cost Cast Sheet**—Civilian applications for cast methacrylate sheet received considerable impetus last year when Rohm & Haas introduced a new, lower-cost cast sheet late in 1954. Untrimmed and unmasked, the new sheet costs about  $\frac{1}{3}$  less than standard cast sheet. The latter is about 99¢ a sq. ft.—the new lower-cost sheet or Plexiglas R is 64.4¢ in 3000 sq. ft. or higher quantities. These prices are for  $\frac{1}{8}$  in. thick material; thicknesses up to 3 in. are available. Plexiglas R is used in signs, glazing, and wherever high-quality surfaces and optical properties are not critical requirements.

**Distribution System**—Another factor that should improve sales is the gradual development of a country-wide distribution system. It is now possible to obtain methacrylate sheet through a local dealer in various sizes and thicknesses in almost every large city in the nation. A few years ago, it was obtainable from very few sources.

Civilian markets for sheet have not changed much. Signs, glazing,

Exports Relating to Plastics		
Material Exported	1954	First 7 Months 1955
	lb.	lb.
Phenol	45,000,000	24,000,000
Cresylic acid and cresols	5,000,000	5,000,000
Phthalic anhydride	11,000,000	12,000,000
Urea and melamine plastics	17,000,000	9,000,000
Film and sheeting	21,000,000	15,000,000
Phenolic laminates	1,000,000	800,000
Cellulose ethers	1,900,000	1,500,000
Cellulose acetate molding material	5,700,000	4,900,000
Cellulose acetate plastics for other uses	8,900,000	6,400,000
Vulcanized fibre	5,600,000	3,800,000
Styrene polymer and copolymer resins	33,300,000	25,800,000
Vinyl and vinyl copolymer resins, uncompounded	31,500,000	21,800,000
Vinyl and vinyl copolymer resins, compounded	10,800,000	9,400,000
Vinyl resin scrap	400,000	300,000
Resins not otherwise classified	44,500,000	32,600,000
Laminated and molded not otherwise classified	4,000,000	2,200,000

and lighting fixture diffusers are the chief outlets. Boat windshields became a greater factor last year. Otherwise, however, it was more of the same.

**In Lighting Systems**—The ceiling light diffusers and general lighting applications have always seemed to be a natural outlet for more methacrylate. It is a fair market, but possibilities seem vastly over-estimated. Various types of plastics are all competing for various portions of this ceiling panel market, but an analysis of the total market for this

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## Polystyrene

IF ANYONE ever had any fears that the volume of polystyrene molding material would decline under the attack of competitive molding and extrusion materials, those fears were certainly banished in 1955. Volume grew from 309 million lb. in 1954 to around 375 in 1955, or 22%, according to Tariff Commission reports. That listing does not include 10 million lb. or more produced by a new supplier who doesn't report. Polystyrene also

made an exceptionally good record in 1954 when it showed a slight gain while most of the other plastics materials registered a decline.

**Toys and Housewares**—Furthermore, there was no serious decline in any classification during 1955. According to the cynics, polystyrene was expected to take a tumble in housewares and toys because of competition from polyethylene, but the percentage of polystyrene used for toys remained about the same and the percentage for housewares declined only a few points. In poundage, the amount for toys increased from something like 30 million lb. in 1954 to well over 40 million in 1955. Housewares poundage declined 5 to 10 million lb. under the 45 million or so used in 1954, which indicates that the polystyrene housewares business still has a good, solid foundation, even though competition has become tougher. There are scores of housewares applications where the color and low cost of polystyrene are ideally suited for the job and it will be a long time before these applications will be surrendered to any other competitive material.

Except for July, every month's volume use (results for November

and December estimated) was close to 30 million lb. or more, with October a possibility for over 40 million pounds. A few years ago the industry was struggling to stay over 25 million lb. a month. In fact, there was only one 30 million lb. month in 1954. There is a bit of mystery as to how 40 million lb. can be sold in one month since there has been little chance for a big inventory build-up and rated annual production capacity has never been listed at much more than 450 million pounds. Apparently the producers are able to produce in larger quantity in those months when they can make long runs on single colors, such as refrigerator orders.






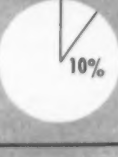



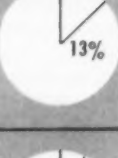

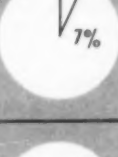





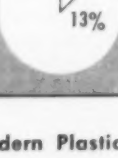
**High Impact**—The influence of high-impact polystyrene is partially responsible for the favorable situation in styrene. No one will reveal exactly how much there was, but those in the trade estimate at least 175 million lb. compared with an estimated 130 million lb. in 1954. It is dangerous to guess because suppliers are unwilling to disclose their proportion of general-purpose vs. impact material, but there is a general feeling that impact material will soon take over at least 60% of the market—if it hasn't already.

Super-high- or extra-high-impact is only a very small portion of the total. Its extra cost of a few cents a pound is some deterrent, but molders in general have found that ordinary impact material will do all that is required for most of the jobs they have in hand.

There are thought to be over 30 million lb. of extruded impact sheet included in this classification compared with 15 or 20 million lb. in 1954. In 1955 almost 90% of it was used in refrigerators. That would be less than 40% of the polystyrene market for refrigerators—vacuum formers expect to eventually obtain 70% or so of that market.

**Sheet Processing**—Continuous extrusion and forming of styrene sheet is still being done by only two or three companies. Techniques seem difficult and applications are limited. Nearly all production by this method is as yet limited to refrigerator parts. But the theory seems so practical that more activity must be expected in this hooked-up extruder-vacuum former operation in the near future. By late 1956, it is also possible that 25% of impact sheet will be used for

## Polystyrene-Type Molding Material by End Uses

		1955	1954
Refrigeration		22%	
Housewares		11%	
Toys		10%	
Wall Tile		14%	
Packaging		15%	
Bathroom and toilet articles		7%	
Phonograph records		2%	
Radio and television		7%	
Miscellaneous		12%	

packaging containers. That would still be less than 40% of the polystyrene market for refrigerator applications.

Another interesting development of this sort is the extrusion of extra-high-impact styrene sheet. So far only one company has been reported as doing this work. The sheet is being used on luggage. Chief property is that it won't crack.

When all the material used in applications where high impact is important are counted up, it is easy to see why volume is big. With 80 to 85 million lb. for refrigerators, some 35 to 40 million lb. of housewares with about one-third of it impact material, 40 million lb. or more for toys where impact material use is about 35 million lb., and with a goodly amount used in industrial applications, that 175 million lb. total of impact material is easy to account for.

Packaging continues as a fast-growing part of the polystyrene business. Estimates vary from 20 to 45 million lb. used in 1955 for packaging, but the high-impact portion is estimated to have been 10 to 15 percent. Suppliers are confident that this market will grow to perhaps 70 to 80 million lb. within three or four years, despite threatening competition. The material seems to be particularly fitted for mass markets. If any more ideas like the polystyrene ice cream container or tomato boats are born, they will help volume sales tremendously.

**Wall Tile**—Enough polystyrene for wall tile was molded last year to cover 100 million sq. ft. of surface.

The huge home building program was, of course, influential in helping to dispose of all that tile, but it is also being widely used to redecorate bathrooms in old houses.

The ceramic tile industry is not taking this plastics competition without a battle. They have developed a thin tile for dry wall application that is being widely promoted. The polystyrene molders can't rest on their oars and expect business to drop in their laps without improving their product to meet this new competition.

In a move to provide a basis for upgrading the plastic wall tile industry and to provide a means for selling quality products, Dow has instituted a guarantee program. This program, designed to assure consumer satisfaction with product, mastic, and installation, is already being furthered by manufacturers representing over three-fourths of the plastic wall tile business.

One of the first steps in this direction has been the development of an extruded length of striated high-impact material that can be sold and applied in long strips. It will be appropriate for office buildings, institutions, and recreation rooms. If this new strip wins acceptance, it could play a large part in more than doubling the present 50 million lb. wall covering volume in a few years time.

**Toilet Goods**—Bathroom uses for polystyrene, including seats, plumb-

ing parts, combs, brushes, etc., continue to grow steadily. The entire field probably used at least 25 million lb. in 1955. Combs alone are reported to require from 12 to 15 million lb. of material annually.

**Phonograph Records**—Some 5 or 6 million lb. of polystyrene are said to be used annually for phonograph records. Presently, there are only a few molders or record companies engaged in the business. Controversy rages over their quality as compared with standard records, but the interest shown by companies who don't have them would indicate that they are beginning to make their "tone" heard more and more satisfactorily.

There is a rumor afloat that one of the largest record producers has a new idea for producing them, but it can't be confirmed. Volume can't grow much in this field until more equipment is put to work, and up until now, there is no evidence of wholesale expansion.

**Industrial Uses**—The field of industrial uses is so large that it is impossible to list all of them here. Electrical, radio, television, clock cases, batteries, lighting fixtures, pencils, air conditioner housings, and bristles for brushes are some of them. Total poundage in this broad classification is probably over 85 million pounds. A big jump in any one or two of them, such as air conditioners and lighting fixtures, could bring the total up to 100 million lb. in short order.

**Foam and Film**—Two different forms of polystyrene that fit into the industrial picture are foam and film.

Foam has been in fairly good volume use for several years as a decorative material, in Christmas ornaments, as bases for commercial display of flowers, in packages for fragile contents, as buoyancy aids, and in other miscellaneous uses. But the impetus it received in 1955 as a low temperature insulation material almost wherever such insulation is required will probably be the starting point for real big-volume use in the future. Foam is cheaper and has many properties that are better than cork. It will not absorb moisture, is light in weight, has excellent structural strength (3500 lb./sq. ft.), and is easy to install. It

Table VI—Styrene Resin Sales, 1952—1955\*

Use	1955	1954	1953	1952
	lb.	lb.	lb.	lb.
Molding materials <sup>b</sup>	375,000,000	309,000,000	298,000,000	249,000,000
Protective coating resins <sup>c</sup> (straight and modified)	90,000,000	80,000,000	82,000,000	66,500,000
Resins for other uses <sup>d</sup>	70,000,000	66,000,000	88,000,000	77,000,000
<b>TOTAL</b>	<b>535,000,000</b>	<b>457,000,000</b>	<b>468,000,000</b>	<b>392,500,000</b>

\*Source: U. S. Tariff Commission, except last 4 months of 1955, which is estimated.

<sup>b</sup>Includes plasticizers, fillers, and extenders; modified and copolymer molding or extrusion materials; resin for foam. One producer does not report.

<sup>c</sup>Includes high styrene-butadiene resin for latex and paper treatment; also resin for styrenated alkyds.

<sup>d</sup>Includes high styrene-butadiene rubber reinforcing resins; ion exchange resins; metal treating resins. Before 1955 this figure also included polyester resins that require styrene monomer.

NOTE: Quantity of high-impact polystyrene sold in 1955 estimated at over 160 million lb.; styrene copolymer molding material at somewhere around 30 million lb. Sheet of all types including styrene, either modified or copolymers, thought to be well over 30 million pounds.

. . . new applications are always popping up . . .

is suggested for warehouses, truck bodies, refrigerator cars, ice cream and dairy plant use, fishing boats, breweries, and fur storage vaults that are now insulated with cork or fibrous glass.

**Home Insulation**—Foam is now being promoted especially for home construction. The heating bill of an experimental house dropped from \$150 to \$90 a month when it was insulated with polystyrene foam last winter. There will be lots of publicity about this and thousands of square feet of insulating foam will be installed in 1956.

**Clear, Sparkling Film**—Polystyrene film as produced by Plax Corp. is just coming into its own after 15 years of development work and overcoming of difficult handling problems. It is a beautifully clear, sparkling film that has been oriented or stretched both ways. It has a metallic ring that enhances its charm for many purposes. Toughness is

built in by stretching—Plax claims it is tougher than acetate, which incidentally, is some claim for a material that is often associated with brittleness.

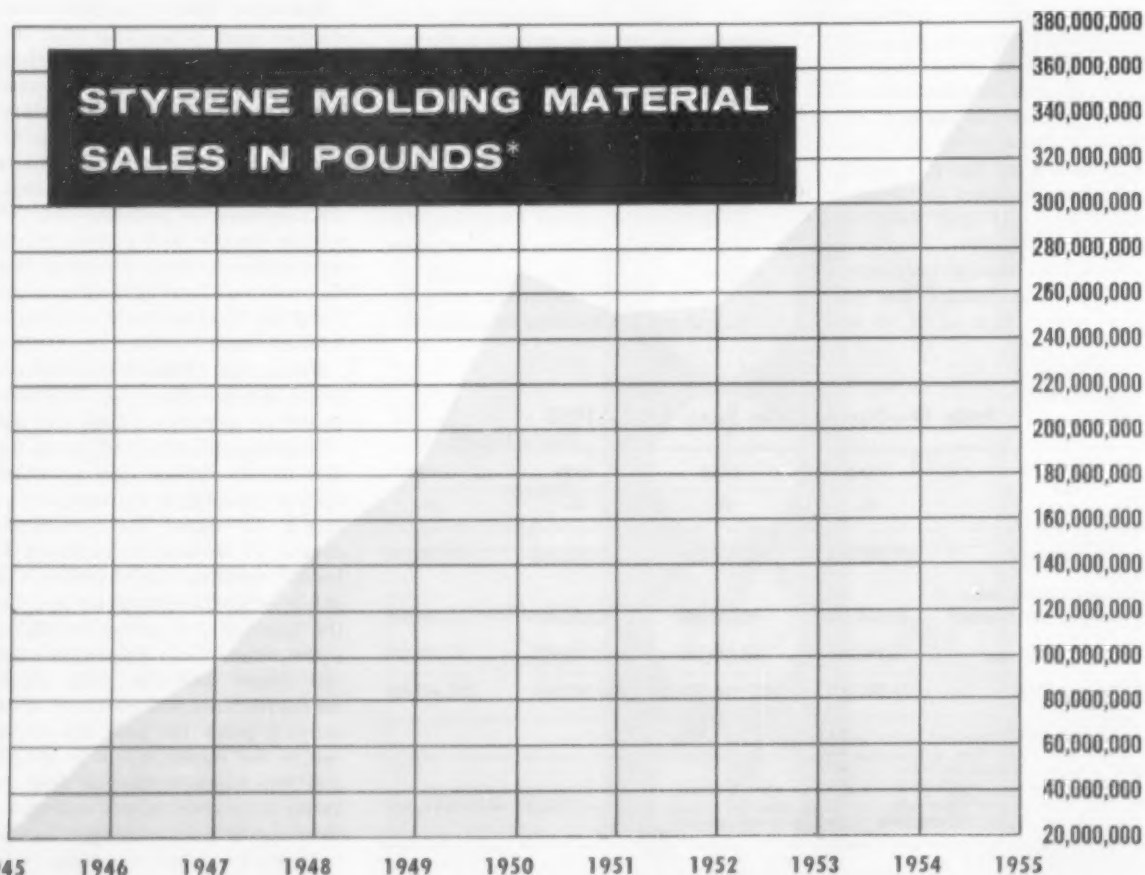
The styrene film is available in thicknesses from 1 to 20 mils—even a thinner gage is a possibility. It contains no plasticizers, is dimensionally stable, non-toxic, and odorless. Not only is it suggested as a material for transparencies, formed picnic-ware, table mats, and various packaging applications, but also as a skin or decorative covering on almost anything, such as fibrous glass acoustical tile, wall tile, high-pressure laminates, and many other materials. As a ceiling panel for light reflection, it can be installed for from \$1.75 to \$2.00 a sq. foot. The producers are confident that a good sized bit of business will develop from this application.

Exports of polystyrene were around 45 million lb. in 1955 com-

pared with 33 million in 1954. All exported material was classified by end use and reported to the government as such, so the export figures are scattered through the various classifications shown in the end-use (To page 189)

## Vinyl Chloride

SEVERAL years ago this section of the MODERN PLASTICS' annual review likened participants in the vinyl chloride industry to players in a poker game. The reason was that vinyl chloride is such a utilitarian resin that new applications are always popping up. Some of them pay off handsomely; others are complete duds. The analogy was drawn to liken vinyl industry executives to poker players who draw to fill a belly straight. If they fill, they are really lucky—if they don't, they are busted unless they have a big surplus of cash to fall back on.



\*Source: U. S. Tariff Commission, except last 4 months of 1955, which is estimated

A great number of those early players filled that straight—far more than percentage players could expect. Today there are a lot of new people who watched the proceedings and now want to get into the game. They have an itch to “draw for that straight.” The big gamble now is: how long can a large percentage of the players keep on filling a belly straight? Some day the odds will have to change. Some day the profits are going to decline; they already have in some segments of the industry. Some day there is going to be enough vinyl resin around to pave all the streets and alleys of this country if present expansion continues. Some day the presently used vinyl chloride resins will be as obsolete as George Washington’s snuff box.

**Full of Activity**—But despite all warnings about the future, it is mighty easy to understand why so many corporations and individuals want to get into the vinyl chloride resin business. Today it is a throbbing, pulsing industry, full of excitement and activity. Sales volume of domestically produced resin increased from 400 million lb. in 1954 to around 500 million lb. in 1955. In addition, the industry used some 20 to 25 million lb. of imported resin.

Every segment of this multiple industry is buzzing with tales of customers who are expanding their activities. And there are still several small-volume uses today that look like potential giants for the future. There seems no doubt that the industry will continue to grow, but the manner of growth may well determine whether the industry becomes orderly or chaotic—whether profits are good, meager, or non-existent.

It is true that the 500 million-lb. volume in 1955 was a magnificent achievement, but capacity is rated at around 650 million lb. with at least 150 million more in some state of planning but not necessarily committed. Capacity for vinyl chloride is difficult to rate. Any rated amount is likely to vary as much as 20% because a producer may change over from one type of resin to another and thus change his production rate. During several periods last year, the industry produced at a 560 million-lb. annual rate without missing a beat. Some varieties, such as certain types of coating and phono-

## Consumption of Vinyl Chloride and Copolymers


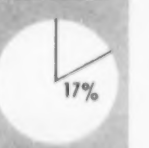

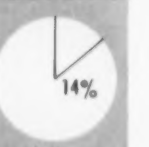

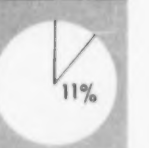



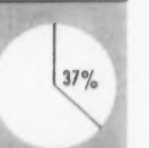


		1955	1954
Film		16%	
Sheeting		9.5%	
Fabric Coating		10.5%	
Flooring		11%	
Molding and Extrusion		36%	
Miscellaneous		17%	

Table VII—Vinyl Chloride and Copolymer Consumption of Resin Produced in U. S., 1952—1955<sup>a</sup>

Use	1955	1954	1953	1952
	lb.	lb.	lb.	lb.
Film under 10 mils	80,000,000	69,000,000	66,000,000	79,000,000
Sheeting over 10 mils <sup>b</sup>	48,000,000	55,000,000	60,000,000	74,000,000
Fabric treatment	55,000,000	42,000,000	39,000,000	37,000,000
Paper treatment	8,000,000	7,000,000	6,000,000	7,000,000
Flooring	55,000,000	34,000,000	25,000,000	—
Molding and extrusion	178,000,000	148,000,000	115,000,000	105,000,000
Protective coating <sup>c</sup>	27,000,000	23,000,000	22,000,000	—
Miscellaneous <sup>d</sup>	46,000,000	34,000,000	26,000,000	37,000,000
<b>TOTAL</b>	<b>497,000,000</b>	<b>412,000,000</b>	<b>359,000,000</b>	<b>339,000,000</b>

<sup>a</sup>Based on U. S. Tariff Commission reports with various estimated alterations necessitated by more varied classifications.









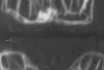






<sup>b</sup>Prior to 1953, the sheeting figure included portions of such products as flooring and other items that are now reported in other classifications.

<sup>c</sup>Protective coatings were reported in miscellaneous in 1952.

<sup>d</sup>This is also an adjustment medium because of the complexities involved in separating vinyl resin uses into their various end use patterns; that is, the total over-all figure is fairly well established, but there is wide difference of opinion concerning the amount used for each end product.

NOTE: About 30 million lb. of resin imported in 1955 is not included in this breakdown. It is thought to have been used roughly as follows: 12 million lb. for film, 10 million for sheeting, and 8 million for extrusion.

**Table VIII—Pattern of Consumption of Calendered Vinyl Film\***

Uses	1953	1954	1955
	lb.	lb.	lb.
 Draperies, bedspreads, kitchen and bathroom curtains	23,000,000	17,000,000	17,000,000
 Yard goods, including film with adhesive applied	10,000,000	9,000,000	13,000,000
 Closet accessories	6,500,000	7,000,000	7,500,000
 Shower curtains	6,000,000	5,500,000	7,000,000
 Nursery goods	4,000,000	5,500,000	4,000,000
 Baby pants	3,000,000	3,000,000	3,000,000
 Table covers	4,000,000	4,500,000	4,500,000
 Appliance covers	3,000,000	2,500,000	2,500,000
 Furniture covers, indoor and outdoor	3,000,000	3,500,000	4,000,000
 Rainwear and outer, including sportswear	10,000,000	9,000,000	12,000,000
 Aprons, including industrial	1,500,000	2,000,000	3,500,000
 Lamination and quilting for other than sportswear	—	—	8,000,000
 Industrial and agricultural (included laminates in '53-'54)	7,000,000	10,000,000	5,000,000
 Wall covering	—	—	5,000,000
 Miscellaneous	13,000,000	11,500,000	20,000,000
<b>TOTAL</b>	<b>94,000,000</b>	<b>90,000,000</b>	<b>116,000,000</b>

\*This table is intended to include only products made of calendered film up to 10 mils in thickness. Everything 10 mils or over is classified as sheeting. However, it is impossible to eliminate a certain amount of overlapping between film and sheeting and between various classifications of products given above. The figures are given as approximations to show trends. Accurate statistics are not available.

graph record resins, were scarce at certain times, but they are comparatively limited-use resins. Such scarcities don't exist for long.

**More Capacity Coming**—There are now nine companies whose total capacity makes up the 650 million-lb. figure. Several of them have expansion plans for the future. At least two or three new producers will come into production in 1956. At least four more have let it be known that they expect to build plants. A monomer plant of 10 or 20 million-lb. capacity is in the works. And there must be five or more others who are still studying the possibility of jumping in. At least three European chemical companies are considering the possibility of setting up shop in the United States. On the other side of the ledger is Simpson Coal & Chemical, which announced that it would build a 30 million-lb. plant in Natchez, Miss., but has now put the plans on a shelf for later reconsideration.

An interesting variation in the new ventures is a vinyl stearate plant that is now supplying drum quantities but will have a sizable pilot plant with a million-lb. annual capacity ready by mid-1956. The producer is Air Reduction Corp.; the plant is located at Calvert City, Ky. Vinyl stearate is used largely as a copolymer with vinyl chloride. It helps to produce a copolymer resin that is extremely flexible without need of a plasticizer.

Most of the newcomers mentioned above are building small polymer plants. The largest so far announced is the 30 million-lb. capacity plant of Escambia Bay Chemical, near Pensacola, Fla. It will include both monomer and polymer. The others, except Allied Chemical & Dye Corp.'s Solvay monomer plant at Moundsville, W. Va., will reportedly produce resin primarily for their own use. Most of them are calenderers, but some extruders, especially wire coaters, are examining the possibilities.

These smaller producers use the following arguments for going into the resin business: They think they can produce resin at a lower cost than by buying it; they have watched the trend toward integration of resin producer and processor and think they have to follow suit in order to maintain a good competitive position in the industry.

**Lure of Price**—Perhaps the price situation is the chief basis for this yen to build a vinyl chloride resin plant. When the base price of polymer was 38¢ a lb. and monomer cost was 10½ or 11¢, big chemical companies looked over the field and thought it promising. Vinyl customers thought a lower price would help them sell more goods or at least improve their profit position. Thus both raw material producers and big-volume users concocted the idea that new resin plants would be profitable ventures.

Then the calenderers in particular, who are the largest individual users, started importing resin from Europe at a cost of 31¢ or less.

Finally, one of the largest producers took the bit in his teeth and reduced the base price to 31¢, although some of the smaller-volume resins for which there was no foreign competition were reduced only 3 or 4 cents. Other producers quickly followed with similar reductions. But the foreign resin was again reduced—the bulk of it now comes in at 20 to 23¢ (including freight and commission), plus a 3¢ tariff, plus 15% *ad valorem*, which makes it 27 to 29¢ a pound.

The answer to that last cut on foreign resin may be another price cut for domestic resin in the near future. It is hard to believe that it will come while vinyl is moving so briskly but, on the other hand, the price break last summer came while vinyl resin sales broke records.

**Large Versus Small Plants**—In any case, the price margin between

monomer and polymer is diminishing rapidly. The day may soon come when small-volume producers who make resin for their own use will find that purchased resins are more economical than those made in their own plants. There is no evidence that vinyl chloride resin can be made at as low a cost in a small plant as in a large plant, and until that fact is proved, there will always be doubt. There are several small-volume plants overseas, but trying to compare foreign production with American mass production is as incongruous as comparing apples with bicycles.

Those producers already well established in the vinyl chloride business, of course, look upon the newcomers with jaundiced eyes. They think that the nine present producers are more than enough to supply the need for some time to come; that when more capacity is needed they will be in a much more advantageous position to supply it; and primarily that the cost of research to prevent obsolescence is a factor which will greatly surprise most of the newcomers.

**Better Resins Coming**—Only laboratory technicians and a few chosen executives in the vinyl business have any idea of what's in store. They are expecting resins that are easier to work, that have better heat and aging resistance as well as better all-around properties, and that perhaps can be used with at least partial elimination of plasticizers.

Copolymers with acrylates, benzoates, maleates, stearates, and many others have been much talked about in the past, but probably those to be heard of in the future are today mentioned only in laboratories. Among the most intriguing of all are the so-called graft polymers whereby molecular chains will be joined end-to-end, rather than combined in the manner now most common. A whole new technique of polymerization which adds to the complications of research and production seems to be under way. Several producers already have equipment for four different kinds of polymerization. In the future they will need even more.

**Research and Markets**—A manufacturer who doesn't have an effi-

cient research setup, or is too far behind to catch up, is going to have a troublesome time in years to come. But suppose he is able to keep up; if there is not a big enough market, research can only help him divide what there is.

The market was surely there in 1955. When an industry increases production from 400 to 500 million lb. in one year, no one is going to weep or worry about lack of sales volume. In addition to that 500 million lb., there were 20 or 25 million lb. of imported material, in comparison with about 12 million in 1954. Over 20 million lb. came from Italy, about 2 million from Great Britain, and 1 million or so from Japan as that country got into the picture for the first time. None came from Belgium which exported about 1½ million lb. to the United States in 1954.

That 25% increase in American sales merits investigation. It was the largest of any big volume plastic (To page 192)

## Polyethylene

**T**HE motto "When better things are made they'll be made of polyethylene," must have been adopted by at least 13 big chemical firms which are now making, or have announced that they will make, polyethylene in the United States.

Imagination can easily get out of control when thinking of polyethylene. Great things were expected from the very beginning, but scarcely anyone anticipated it would grow so fast. (See Table X, p. 96.)

Since 1950, the sales figure has grown from around 50 million lb. (Table XI, p. 207) to something over 350 million lb. in 1955, or a seven-fold increase. In 1955, sales increased over 1954 by almost 60 percent. There is no accurate record since the Tariff Commission report does not include the first three months of the year, but, no matter what the exact figure may be, there isn't any doubt that the achievement is sensational.

**Production vs. Sales**—The executive vice president, Howard Bunn,

**Table IX—Pattern for Consumption of Plasticized Vinyl Sheet, 1955**

Application	million lb.
Luggage	5
Inflatables	11.5
Upholstery	42
Jacket material	4
Handbags, wallets, key cases	20
Laminating	11
Industrial	3
Wall covering	2
Miscellaneous	5
	103.5

# Estimated Polyethylene Consumption, by End Uses

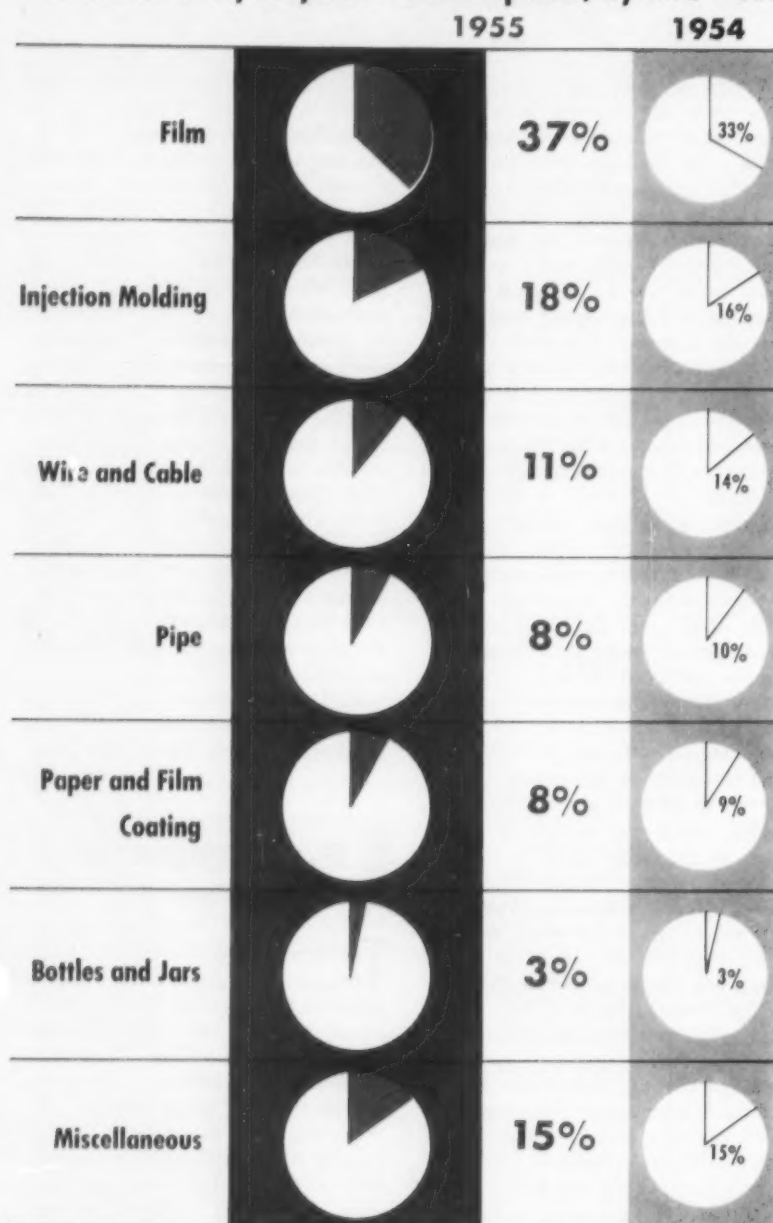


Table X—Estimated Consumption of Polyethylene, by End Uses

End Use	1953	1954	1955	1960 <sup>b</sup>
	lb.	lb.	lb.	lb.
Film and sheeting	45,000,000	70,000,000	130,000,000	300,000,000
Molding	21,000,000	34,000,000	63,000,000	150,000,000
Wire and cable insulation	32,000,000	29,000,000	38,000,000	100,000,000
Pipe <sup>a</sup>	18,000,000	22,000,000	29,000,000	100,000,000
Coatings	15,000,000	20,000,000	27,000,000	100,000,000
Bottles	6,000,000	7,000,000	9,000,000	50,000,000
Exports	—	12,000,000	40,000,000	—
Miscellaneous	—	13,000,000	14,000,000	50,000,000
TOTAL	137,000,000	207,000,000	350,000,000	850,000,000

<sup>a</sup>This does not include scrap which could have been over 12 million lb. in 1955. No reliable figures are available.

<sup>b</sup>Estimate suggested by one raw material supplier.

of Union Carbide has stated that total production for 1955 will be 400 million pounds. That would leave quite a margin between sales and production, which is not easy to understand. Tariff Commission reports have been showing a 3 to 5 million-lb. difference between sales and production each month, but the impression has been prevalent that almost every available pound is being taken up as fast as it is made. Producers deny that they have much inventory on hand.

Several reasons have been suggested for this difference. One is that some producers may not be reporting exports, which are believed

(To page 206)

## Nylon

INCREASED use of molded nylon parts for hardware, gears, bushings, and moving parts to replace metal where lubrication and wear have been problems, was probably much more pronounced in 1955 than in any other year. Molders and their customers have now become familiar enough with nylon so that they can quickly spot applications where it will do the job. With that knowledge, gained by experience, molders are in a much better position to merchandise their services. Development of new nylon products goes on endlessly. And there is a steady increase in the number of molders who have discovered this comparatively new field and have had the patience to put up with its complexities and necessity for fine workmanship.

Volume of molding material sold is a secret locked in the vaults of producers, who always insist that estimates published in the past have been too high. But if the intense interest shown in this material by both foreigners and prospective new producers is any criterion, nylon must be considered a plastic with a vast potential.

**Price Reduction**—A significant trend in nylon's progress last year was a reduction in price from \$1.60 to \$1.45 a lb. for the most widely used of the molding formulations. Guessing on what is going to happen to nylon's price structure is a dan-

(To page 212)



## Plastics Push into BLUE CHIP MARKETS

Application advances in 1955 and trends for 1956 are based on better design and engineering, more and better materials, more automatic equipment, and big investments in plant and tooling

**T**ECHNICALLY, the phrase "blue chip" is applied to a market not only because of size alone; equally inherent in the blue chip market concept is the idea of quality—of markets soundly based on products of accepted quality.

It is to the credit of the plastics industry that in pushing into these markets in greater volume in 1955, it has in large measure maintained this concept of quality. In so doing, as production and sales figures of 1955 prove, the industry has not only enjoyed a record year, but has also established a pattern for further expansion in the future.

Described in the following pages are a number of plastics applications which stood out during 1955 as being indicative of the directions which such expansion is likely to take. The applications described by no means represent the sum total of the year's activities. Rather, they have been chosen from among many to illustrate the strides being made by the plastics industry in broadening the bases of plastics applications to provide new large-volume outlets for increased production.

Although not covered in this re-

view, it should be noted that 1955 also witnessed a sound expansion along conventional lines in existing markets for plastics materials. Note should also be made of applications reported on during the year in *MODERN PLASTICS* which are still too new to evaluate. Typical of these is the polyester-fibrous glass hammer handle introduced by a leading manufacturer of tools toward the end of 1955 (*MPL*, Oct. '55, p. 97). Claimed to be twice as strong flexurally as a solid steel handle and 61.5% stronger than a tubular steel handle, the plastic handle in 1956 conceivably can mark an important new trend in tool design. In late 1955, however, tool manufacturers were still analyzing detailed reports on consumer and retailer reaction to the new handle.

Credit for the over-all advances made in plastics applications in 1955 belongs to many sources. For one thing, new design thinking aimed at upgrading plastics products helped strengthen consumer acceptance and provided a healthier climate in which to experiment with new applications. More tangible credit belongs to the job done during the

year in improving plastics materials, in refining processing techniques, and in adapting the principles of automation to the production of plastics products.

Among this wealth of activity, it would be difficult indeed to point to any one group of individual developments as being solely responsible for the banner year of 1955. True, there were some that stood out above others as having a more dominant bearing on plastics applications. Sheet forming, for example, greatly extended its sphere of activities into the manufacture of a wider range of consumer and industrial end-products—and, thanks to the progress being made in the area of continuous sheet forming directly from the die of an extruder or from a roll of flexible plastics sheeting, prospects for future market development loomed even brighter (*MPL*, Apr. '55, p. 87).

Material-wise, fibrous glass-reinforced plastics resins had one of their biggest years, with considerable attention being focused on the new reinforced molding compounds that made their appearance during the year. Similarly, almost every

market for polyethylene showed a substantial increase in 1955—and once the new low-pressure polyethylene materials are available in production quantities, the annual rate of consumption can be expected

to go even higher (MPL, Sept. '55, p. 85; MPL, Oct. '55, p. 100).

But from the over-all viewpoint, it was the combination of many new tougher, more versatile materials (see review starting on p. 78) and

many new faster, more automatic processing techniques (see review starting on p. 115) that enabled plastics to push in increasing volume into the profitable blue chip markets.

## IN BUILDING CONSTRUCTION



Courtesy Lunn Laminates, Inc.

Vinyl skin laminated to metal face of door based on honeycomb sandwich construction provides permanent coloring and protection against abrasion

Courtesy Wasco Flashing and Rohm & Haas Co.

Geodesic structure made up of reinforced plastics panels attached to wooden frame permits maximum space enclosure

Courtesy Kawneer Co.



Dome-like acrylic skylights are important elements in modern design aimed at greater daylight illumination in buildings

Courtesy Bakelite Co.



Polyethylene film stretched over wooden scaffolding during building construction protects workmen and materials from inclement weather



**U**SE of plastics materials in almost every aspect of building construction, from laying a foundation to erecting a finished structure, reached a new high in 1955. Dollar-wise, plastics' share in the over-all market was still relatively small (plastics accounted for an approximate \$½ billion out of an estimated \$38 billion total building market in 1955). However, new concepts in building design and construction which made themselves evident during the year indicate that plastics will be finding greater application in the building industry within the next few years.

Although such advances were made along a broad front, several of 1955's specific building applications deserve mention as being indicative of significant trends:

**Foundations and Forms**—In this phase of building activity, polyethylene has become a major plastics factor in 1955. Polyethylene film is being used, for example, as a moisture vapor barrier under floor slabs and in concrete foundations. In the form of tape, both as unsupported film and as a coating for cloth-backed tape, the material is also used as a means of sealing joints and stopping seepage in concrete walls. (Polyester resin-fibrous glass laminate, incidentally, is another material that is finding extensive use in repairing concrete walls and foundations; see p. 99.) And in still another type of application, a polyethylene-coated paper is put to work as a lining for concrete forms (MPL, Feb. '55, p. 207). Because of the low water-transmission rate of the polyethylene, the lining extends the curing time of the concrete, giving it a harder surface.

**Walls and Roofs**—Although commercial applications are still in

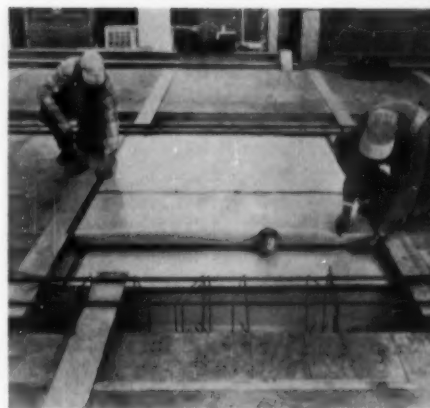
small volume, considerable interest is expressed in the architectural possibilities of walls built up of "sandwich" panels based on phenolic-impregnated paper honeycomb or styrene foam cores and plastic, plywood, or metal sheeting as the facing materials (MPL, Dec. '55, p. 92). New structural possibilities, particularly for carports, patio roofs, patio walls, greenhouses, and similar units, are also inherent in the design of a microwave relay station erected in 1955. The transparent sidewalls of the station consist of extruded acrylic panels joined together with interlocking tongues and grooves formed during extrusion.

Two greenhouses built during

the year were among the other structures that showed an imaginative use of plastics. One is made up of sheets of rugged polyester-fibrous glass laminate curved over a lightweight aluminum frame (MPL, Dec. '55, p. 192); the other consists of a double layer of polyethylene film applied to a wooden frame.

On the actual working level was the adaptation of polyethylene film as a window shield stretched across scaffolding during building construction to protect workmen and materials against inclement weather (MPL, June '55, p. 194).

**Glazing**—With architectural emphasis aimed at a greater degree of (To page 214)



Courtesy Bakelite Co.

Lining form with polyethylene-coated paper produces better concrete surface



## IN REPAIR WORK

**T**HE large number of specialized patching compounds and repair kits based on plastics materials that were marketed in 1955 testified to an increasing public awareness of the quality salvage jobs which plastics can accomplish on a wide range of products—from torn, dented, or rusted-out metal automobile body fenders to broken handles on kitchen pots and pans. In 1954, plastics patching kits (involving mostly fibrous glass cloth and polyester or epoxy resins) had been limited almost entirely to work on reinforced plastics (or wooden) boat hulls and on reinforced plastics car

bodies; in 1955, however, improved resin compounds made it possible for plastics to be put to use in the repair of a wider range of products fabricated of metal, wood, concrete, or china (MPL, Dec. '55, p. 98).

Two types of repair kits captured most of this business in 1955. One type offers a supply of fibrous glass cloth or mat which is laid over the area to be repaired, impregnated with the liquid resin, and the combination allowed to harden. This is the same type of kit that was used in previous years for repairing reinforced plastics products—which application, incidentally, continued

as its largest volume outlet in 1955. There was shown, however, an increasing use of the repair kit in automotive body repair work (especially in mending rusted or perforated automobile gas tanks which present a fire hazard when conventional welding or soldering techniques are used), in repairing rotted-out wooden window sills, in stopping leaks in concrete foundation walls, and in patching metal pipes, gutters, and downspouts.

The second type of plastics repair kit, which first came to notice in 1955, contains a "cold solder" composed of finely divided metallic

Simplified repair job on dented fender begins with laying up and impregnating glass cloth  
Photos courtesy Fibreglass-Evercool Co.



After being left to harden overnight, resin-fibrous glass patch is carefully sanded down



Painting and polishing the patched area completes low-cost repair job



particles combined with selected plastics resins, usually epoxy or polyamide. This is the same material that made a name for itself in 1954 in the production of durable vacuum forming molds. Although "cold solder," which can be handled like putty and applied without heat to metal, plaster, reinforced plastics, and other materials, was still in lim-

ited application in 1955, potential markets look big.

As the markets are now shaping up, one of the biggest outlets for "cold solder" will probably be in the home handyman field where it can be used for easy repair jobs on leaking radiators, corroded boilers, and broken utensil handles.

Another major outlet under con-

sideration is the industrial field where the material can be used for such jobs as sealing porous castings or seams in metal duct work and the economical repair of broken-down machinery. It is even suggested that the material may someday revolutionize fabricating and assembly operations in metal product manufacturing.

## IN PACKAGING



Major innovations in plastics packaging applications in 1955 included all-plastics aerosol with melamine body...

Courtesy Angelique



... cutlery box made up of formed vinyl sheets electronically sealed together ...

Courtesy B. F. Goodrich Chemical Co.



... "skin package," in which clear sheet forms a protective sheath over items...

...and linings for polyethylene bottles. (Unlike in demonstration model below, linings are inseparable from bottles)

Courtesy Plax Corp.



**F**UNDAMENTAL changes in merchandising techniques, instituted by the supermarkets and followed by other types of retail outlets, pushed plastics materials to new heights in the packaging industry in 1955. As the basic emphasis in retailing practices centered more and more on self service selling, the need for visual packaging that would both protect the product and encourage impulse buying created a heavy demand for transparent plastics materials.

Plastics usage in 1955 for this type of packaging took three distinct forms: 1) clear plastics film (including polyethylene, vinyl, saran, cellophane, and polyester) wrapped around a variety of products ranging from carrots to sample dabs of paint; 2) crystal clear molded styrene rigid containers (in one example, the use of a transparent container for packaging ice cream was credited with increasing sales by 200 to 400% at some retail stores; *MPL*, Nov. '55, p. 92); and 3) vacuum formed "skin" packages.

The last category, as the newest of the three, attracted most of the attention in 1955 and by year's end was already boasting of annual production runs in the billions of units (*MPL*, Apr. '55, p. 87). The "skin" packaging technique, in which items are encased in a tight, transparent plastic sheath (acetate, butyrate, or cast vinyl) in a single vacuum forming operation had barely gotten off the ground at the beginning of the year when it was already being adopted for volume use by several large hardware manufacturers. At first, the technique was thought to

be suitable only for carded items but a packaged knob and screw set and a packaged model Indian toy set introduced in 1955 successfully demonstrated the possibilities of forming the sheath directly over the articles themselves while they are loaded in a mold.

Other types of sheet formed packaging applications which made their debut in 1955 indicated a big potential market for plastics in one of the most important (and profitable) phases of the entire packaging industry—food packaging. From Canada came news of an attractive, functional package for liver, cheeses, etc. formed of polyethylene sheet (MPL, Apr. '55, p. 87) and in the United States a package formed of rigid vinyl sheet (incidentally, one of the first adaptations of rigid (To page 215)



Courtesy Crown Cork & Seal Co., Inc.

Expansion in such established markets as styrene refrigerator containers also reflected increased interest in plastics for packaging in 1955

## IN TABLEWARE

**D**EVELOPMENTS in decorating melamine dishes and in improving the quality of molded cutlery handles (made of both thermosetting and thermoplastic materials) held center stage in the plastics tableware field in 1955. Dominating activity was the perfection of a practical and economical technique of molding multi-color decorative patterns into the surface of melamine dishes. Involved in the process is a lithographed, melamine-impregnated, paper-like foil which is inserted into the mold during molding operations and, on curing, becomes an integral part of the finished dinnerware piece (MPL, July '55, p. 90).

As a supplement to conventional solid-color melamine dishes, the idea of decorated pieces that would appeal to style-conscious housewives had long been under discussion, but 1955 marked the first relatively large-volume commercial application of this type of thinking by several leading tableware manufacturers. By the year's end, a number of other molders were already expressing keen interest in the possibilities inherent in this technique.

In the molded cutlery handle field, a change in emphasis was also noted in 1955, directed towards the use of tougher, heat-resistant plastics materials. Here was an obvious appeal to that wide-spreading portion of the consumer and commer-

cial markets which makes use of automatic dishwashers. One leading flatware supplier, for example, marketed a line of cutlery in which colorful melamine handles were molded right on to the tang and bolster of each piece. Not only can

Melamine dinnerware set with design molded-in as integral part of dishes combines attractive appearance with break resistance and serviceability  
Courtesy American Cyanamid Co.





Cutlery handles molded of new type of tough, heat resistant cellulose acetate are reported to be completely "automatic dishwasher-proof"



Same material as described at left is used in the production of new durable but high-style, color-matched dinnerware and cutlery handles

Photos courtesy Hercules Powder Co.

the melamine-handled flatware be washed in automatic dishwashers without distorting, discoloring, or dulling, but the fact that they are designed to complement various styles and brands of melamine dishes introduced a new and heretofore undreamed of concept in

tableware styling—matching dishes and cutlery handles.

Another manufacturer boosted the stock of the cellulose for this type of application by successfully introducing the first "dishwasher-proof" cutlery handles to be commercially produced using a new type

of tough, heat-resistant cellulose acetate (MPL, Oct. '55, p. 94). Also lending weight to the tableware styling trend described above, was the report that a set of dishware molded of the same new acetate in colors matching the cutlery handles would soon be on the market.



## IN BOATS

**R**EFINEMENTS in production techniques for turning out large one-piece reinforced plastics boat hulls went forward at such a rapid rate in 1955 that one molder anticipated that by 1960, "over 50% of all boats below 16 ft. in length will be made of this versatile material."

To the boat industry this was good news. Hulls fabricated of polyester-fibrous glass laminates have long been recognized as superior to those made of wood. They are light in weight, exceptionally strong, will not dry out, rot, or corrode in any weather, and require a minimum of repair. Low-cost repair kits are available. See p. 99.

About the only thing holding reinforced plastics back from this lucrative market has been slow production methods. Now, with emphasis being placed on huge hydraulic molding presses and huge precision machined metal molds, the mass production of reinforced plastics boat hulls is within grasp. One manufacturer, using a set of molds weighing 65,000 lb. to produce a 15-

ft. one-piece lap-strake boat hull (MPL, June '55, p. 112), reports that he can now turn out 50 hulls a day instead of the 5 formerly possible—and at lower cost. Another leading manufacturer is using a 700-ton hydraulic press for fast production of stronger, more uniform one-piece hulls for outboard boats.

But, although all-plastic hulls will probably eventually snare a good

share of the boat market, the conventional wooden hulls are also starting to develop into a market for plastics in the form of foams. Many boat builders in 1955, for example, were showing enthusiasm for a new technique developed by the U. S. Navy for making wooden boats virtually unsinkable by inserting blocks of styrene foam into all available spaces (MPL, June '55, p. 201).

One-piece molded plastic boat hulls are produced rapidly on 700-ton hydraulic press



Courtesy Goodyear Aircraft Corp.

## IN LIGHTING

**B**ASIC to the advances made by plastics in the field of interior illumination in 1955 were two architectural trends that gained momentum during the years: 1) a demand for greater flexibility in lighting systems to accommodate the move to more open plans in modern building design; and 2) a desire for smart new lighting fixtures to harmonize with contemporary interior decoration.

In lighting for industrial and commercial purposes, both of these requirements were being met by a dominant swing to systems of over-all illumination involving sheets of translucent or transparent plastic suspended on metal tracks beneath the true ceiling. Although, in 1955, as in previous years, the "ceilings of light" found their major outlet in banks, schools, hospitals, offices, factories, and similar buildings, interest was beginning to be expressed in their possible use in homes. Particular emphasis was given to the modern decor inherent in the system, the high level of illumination possible, and the fact that this type of over-all lighting would be especially suitable for projected homes of the future in which space arrangements based on lightweight movable partitions would be subject to constant change (MPL, Feb. '55, p. 85).

Taking its place beside vinyl and

acrylic as possible materials for use in the "ceilings of light" was oriented styrene sheet, which, in 1955, received Underwriters' approval.

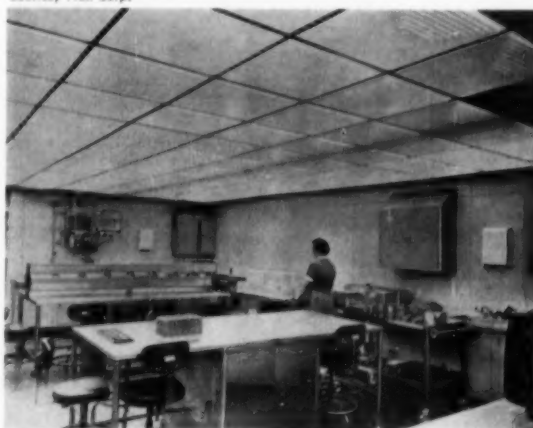
In the field of residential lighting, many of the innovations in lighting fixtures which were introduced in limited numbers as high fashion items in 1954, including sleek bullet-shaped phenolic lamp shades and "bubble" lamps fabricated of vinyl, were made available in larger quantities (and, consequently, at lower costs) for the average home. One interesting development in lamp design in 1955 was a styrene diffuser with molded-in ribs which also function as louvers.



Courtesy Lightolier, Inc.

Molded of styrene in one piece, large circular diffuser clipped to shade of floor lamp has integral ribs which serve as eye-shielding louvers

Courtesy Plax Corp.



Ceiling panels of translucent styrene sheet have received Underwriters' approval and are now added to vinyl and acrylic sheets to meet the needs of this rapidly growing market

## IN FURNITURE

**T**HE position long enjoyed by wood in the construction of upholstered furniture and case goods was beginning to find strong competition from plastics materials in 1955. Especially noticeable in the move to secure a larger share of the huge market was the heavy concentration on molded reinforced plastics parts.

In the design and construction of upholstered furniture, for example, the big news in 1955 was the use being made of the material for structural components customarily fabricated of wood. From one manufacturer came two pieces—a stylized chair, incorporating a one-piece molded reinforced plastics

shell, and a sofa with reinforced plastics end bells, front rails, and backs (MPL, Nov. '55, p. 104). Both pieces were covered with vinyl sheeting upholstery material—another established furniture application that continued to grow in volume and importance in 1955.

Of special interest in the case of



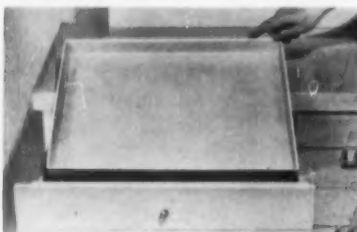
Modern styling, which would be costly to achieve with all-wood construction, is economically accomplished in design of sofa by using molded reinforced plastics frame



Matching chair has molded one-piece reinforced plastics shell, foam cushion back, and vinyl upholstery

Photos courtesy Kroehler Mfg. Co.

Reinforced plastics school desks rate high in seating comfort and durability



Courtesy Bakelite Co.

Vacuum formed styrene liners for furniture drawers protect clothes from splinters and simplify cleaning job

Courtesy Structurlite Plastics Corp.

another chair with a molded reinforced plastics frame was the fact that the manufacturer set up to do its own molding. Some observers interpreted this as a trend toward reinforced plastics molding taking its place alongside woodworking and upholstering in furniture manufacture.

Materials development in 1955 also pointed to the field of cushioning as a possible large-volume outlet for the foamed plastics. Vinyl foam and polyurethane foam, both of which were already under test as seat cushions for automobiles, subway cars, etc., are possible applicants for the consumer market as well (MPT, Sept. '55, p. 114). Although the two materials have certain disadvantages which must be eliminated before they can be used to any great extent for cushioning, a high note of promise was sounded by the fact that large-volume sup-

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## IN SWIMMING POOLS

**A**S A result of an industry-wide program aimed at cultivating mass markets for low-cost swimming pools, plastics took on added importance in 1955 as prime materials for pool construction. Having gone as far as possible, price-wise, with concrete and metal, manufacturers were turning in increasing numbers to the concept of plastics pools that would fall within the

budgets of the middle-income group.

In previous years, plastics emphasis had been placed on portable inflatable pools up to 20 ft. in diameter and made up of heavy-gage vinyl liners supported around the circumference by a wire fence. In 1955, however, plastics were successfully put to use, for the first time, in the construction of permanent home swimming pools.

Of the several variations of such pools introduced during the year, the most dramatic advances were made in the design of units based on prefabricated reinforced plastics sections. At least two leading manufacturers of swimming pools have already adopted the idea and, reportedly, the number may be increased to half a dozen by 1956.

From the standpoint of costs, the

prefabricated reinforced plastics pools have much in their favor. A four-section pool can be assembled, fitted with the required plumbing, finished with a concrete border, and filled, all within four day's time, at a cost of between \$2500 and \$3000—one-third to one-half less than concrete or steel structures of comparable size. The finished pools are economical to maintain, will last for years under all types of weather conditions, and can be self-repaired, when necessary, with an easy-to-use repair kit containing fibrous glass cloth and polyester resin (MPL, Sept. '55, p. 98). In addition, the pools are now available in a variety of shapes, including oval, round, and various irregular shapes, in sizes up to 15 ft. wide by 42 ft. long.

Although the reinforced plastics pools have been on the market for only a matter of months, reception has already been sufficiently enthusiastic to encourage manufacturers to invest in new molding and curing equipment to turn the large sections out at faster production rates—and consequently at even lower costs.

Plastic-lined pools also attracted much attention during the year. In

Prefabricated reinforced plastics swimming pools herald new era in low-cost pools for mass markets

Molded sections of prefabricated pool can be joined together, lowered into excavated hole, and bordered with concrete in four days



Photos courtesy Delorich Enterprises, Inc.



this type, a concrete-block pool is first built up and a sheet of vinyl then rolled out on the loose earth floor and over the concrete side walls (MPL, May '55, p. 191). Because of the easy-to-clean, watertight liner, many of the construction

and maintenance costs involved with conventional concrete pools are eliminated. Completely installed and equipped, a 16- by 34-ft. pool of this type will sell for about \$2600, bringing it also into the category of swimming pools for mass markets.

## IN MATERIALS HANDLING

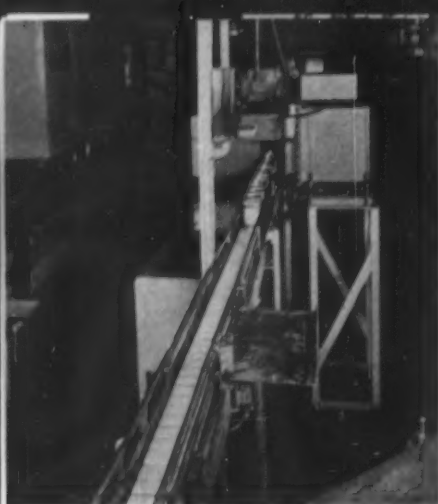
**T**AKING over at the point where other materials have failed in the performance of many of the specialized materials handling jobs created by the complexities of modern industry, plastics started to move into a more prominent position in the field in 1955. More important, the progress taking place in the field during the year was being watched with more than passing interest by a wide range of industries and, reportedly, many of the proposed materials handling applications now being aggressively explored for 1956 and future years involved an even greater use of plastics.

From the standpoint of potential large-volume usage, perhaps the most important of these materials handling applications to gain recog-

nition in 1955 was vinyl-type conveyor belting—tough, abrasion-resistant, oil-resistant, and easy-to-maintain (MPL, Oct. '55, p. 112). Two versions of such belting are at work—a reinforced vinyl-impregnated belt (in which each of the fabric plies of the body is impregnated with vinyl) and a vinyl-covered belt (in which the solid woven fabric core is coated top and bottom with a layer of vinyl). Although initial applications of both types were directed primarily at specialized operations for which rubber belting had proved inadequate (such as food handling), many users in light and heavy industry were starting to experiment with its possibilities as a replacement for rubber in some of the standard packaging, as-



Courtesy The B. F. Goodrich Co. Vinyl-impregnated conveyor belts are ideal for packaging and assembly lines



Courtesy E. I. du Pont de Nemours & Co., Inc.

sembly, and loading applications. Of particular interest were the tests being run by the Bureau of Mines on the use of the belting for underground conveyor work in coal mines (in England in 1954, over 15,000 tons of vinyl had gone into fire-resistant belts of this type).

Growing use was also noted for conveyor belts made up of molded nylon sections, particularly in plants where contamination from lubricants and other sources must be



Courtesy Luria-Courmand, Inc.  
Molded-in ribs in styrene tote boxes act as holders for divider panels

Conveyor belts of molded nylon parts are used in food packing plants

avoided and where resistance to corrosion is desirable (MPL, Aug. '55, p. 85).

In tote trays, formed plastics pieces stole the spotlight in 1955. Credit for the advances made by this application in 1955 belongs to two sources: 1) the availability of tougher, more resilient plastics (particularly the rubber-plastic alloys) which, by providing shock absorbercy, protect delicate component parts during transit; and 2)

refinements in forming techniques which permitted the design of supporting undercuts and contoured recesses into each individual piece. In one series of typical styrene alloy tote boxes marketed in 1955, for example, molded-in ribs on each of the four sides double as stiffeners for the sides and as holders for panels used to compartment the box.

For in-plant use, as well as for shipping and storage, the use of molded, fabricated, or spray-on linings for tanks or containers was another application that took on added importance in 1955 (MPL, Dec. '55, p. 85). By providing corrosion resistance for the handling of foods, chemicals, and similar corrosive materials, the linings obviated the need for specialized shipping or storage equipment which involves expensive metal alloys and other non-plastics materials. Convenience of installation and spectacular savings in shipping costs accomplished by substituting plastic-lined lightweight units for heavier equipment also helped make industry more aware of the advantages to be obtained by the use of plastics.



## IN HOUSEWARES



**A**CTIVITIES in the plastics housewares field in 1955 were directed not so much to developing new areas of application as they were to more soundly establishing existing ones. Imaginative product design and better engineering teamed up to expand the sales potential of such basic plastics housewares as tumblers, ice buckets, basins, trays, pitchers, etc.

In many of these standard applications, the most obvious trend was the swing from the rigid materials to flexible polyethylene (MPL, Oct. '55, p. 100). It was estimated that overall consumption of polyethylene molding materials jumped from 34 million lb. in 1954 to 60 million lb. in 1955 and that the biggest portion

of this increase went into the housewares field. To absorb this poundage, polyethylene applications had to cover a broad front. Special note was made, however, of the increase in the number of very large waste baskets and trash cans being successfully molded in one piece (MPL, Dec. '55, p. 113).

Adding to the bright prospects for polyethylene in future housewares markets was the appearance in the closing months of 1955 of the new polyethylenes (MPL, Sept. '55, p. 85). Because of its stiffness and its high heat resistance, the material can conceivably fill the gap that now exists in the housewares field between the rigid materials (such as styrene) and conventional flexible polyethylene, especially in the design of nursery and other articles that have to be boiled.

Courtesy Bakelite Co.  
Large 10-gal. trash can is molded in one piece of flexible polyethylene

In other areas of the housewares market, consumers were similarly wooed with high-quality products, ranging from conventional molded styrene housewares, such as shelf planters, breadboxes, and picnic-ware (MPL, June '55, p. 95), to such dramatic innovations as salad bowls formed from 1/4 in. thick acrylic sheet (MPL, Nov. '55, p. 114).

Even such long-established applications as flexible vinyl dinner mats showed the effects of upgrading. Several of the mats introduced in 1955, unlike previous models which were often simply copies of linen materials, were styled in completely original textures and colors.



Courtesy B. F. Goodrich Chemical Co.  
Embossing and laminating are used to create original styling for vinyl dinner mats



Courtesy Koppers Co., Inc.  
Breadbox molded of impact styrene typifies quality housewares marketed in 1955

## IN TOYS

**I**N VYING for a greater share of the \$1 billion market for toys (\$1½ billion is anticipated by 1960), plastics applications in the toy industry followed the same basic pattern set the previous year—a trend towards higher-quality toys based on newer materials, newer processing techniques, and better design. The results were again impressive. Nearly half of the toys sold across retail counters in 1955 were made entirely of plastics or incorporated one or more plastics parts. Of even greater interest than over-all volume, however, was the potential inherent in the noticeable swing in 1955 towards the use of plastics in the design of toys in the so-called higher price brackets (from \$5 to \$15 and over).

Traditionally, plastics' major outlet in the toy field has been—and will probably continue to be—in toys selling for under \$5. In 1955, sounder engineering practices and more imaginative design did much to expand this outlet and meet the competition of cheap metal toys imported from Japan and Europe. Refinements in materials and techniques also made a basic contribution. Flexible polyethylene and elastomeric vinyl, for example, proved more and more popular in the design of toys that could be labeled with the consumer-appealing tag, "unbreakable" (MPL,

Model crane is molded of acetate and operated by remote control

Courtesy Eastman Chemical Products, Inc.



Flying model plane (left) is assembled from lightweight formed styrene parts (right)

Photos courtesy Bakelite Co.



Courtesy Tigrett Industries  
Practically indestructible pull  
toy designed around molded  
polyethylene and vinyl parts  
combines play value and safety



Bath toys of polyurethane foam  
are competitive with rubber toys  
from standpoint of softness,  
strength, and cleanability

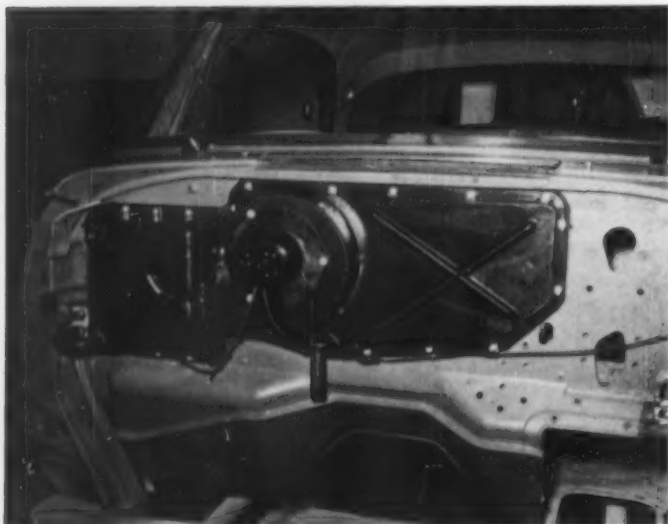
Courtesy Mobay Chemical Co.



Nov. '55, p. 110). A strong trend was also evident in the use of vacuum forming to give new life to such established playthings as painting sets and model car sets and to create entirely new types of revolutionary mobile toys made up of vacuum formed parts cemented together (MPL, Apr. '55, p. 87). And the development of polyurethane foams that can be molded into bath-type toys opened new possibilities in a field heretofore reserved for foam rubber (MPL, Aug. '55, p. 102).

Among the higher-priced toys, this same attention to sound engineering and design to create a quality product paid rich dividends. With the accent this year so definitely on realistic toys, plastics (which make the reproduction of a wealth of detail so economical) became prime materials of construction. The crop of 1955 plastics toys that were forerunners in the field of realism covered a broad front. One educational toy, a working scale model of the famous Mt. Palomar telescope, for example, was designed and scaled from the blueprints used in the construction of  
(To page 220)

## IN AUTOMOBILES



Courtesy Chrysler Corp.

By molding auto heater housing in two parts of reinforced plastics (polyester-glass-fiber), high costs associated with assembly of metal stampings are eliminated

**A**S AUTOMOBILE production overshot all expectations in 1955 to reach a record total of approximately 7,800,000 cars in 1955, the poundage of plastics being absorbed by the automotive industry also increased to a record new high (MPL, March '55, p. 230). Much of this increase could be attributed to the natural growth in the use of plastics for established automotive applications (e.g., acrylic lenses and medallions; vinyl-coated fabrics for upholstery, trim, etc.; plastics steering wheels and knobs; etc.). But a good share of it also belonged to the newer applications which pushed the estimated amount of plastics being used to somewhere over an average of 11 lb. per car. In a good number of the 1956 cars, many of these applications had already passed from experimental, spotty

Modern Plastics



Station wagon roof lining formed of tough, resilient styrene copolymer sheet acts as insulation against extreme heat or cold



Lining is installed in one piece by simply slipping it through the rear of the wagon and fastening it in place beneath the roof

Courtesy U. S. Rubber Co.

use into large-volume application; and plans for 1957 model cars reportedly involve an even more emphatic swing to plastics.

Of the many new applications that presaged a future growth in market potential, one of the most talked about in 1955 (as was the case in 1954 and 1953) was the adaptation of polyester-fibrous glass laminates to automobile components—only this time, it was the smaller parts (such as defroster nozzles, moldings, radio speaker housings, etc.) that attracted more attention than entire automobile bodies and large body components. Most publicized of these new and smaller pieces was a molded heater housing for Chrysler, which has enjoyed a production run already well into the millions. Like other small components, the production of the heater housing was based on the premix molding technique (resin and rein-

forcing materials are mixed together into a putty-like mass before being placed in the mold)—a method which permits economical mass-production runs (MPL, Nov. '55, p. 125).

In the category of larger reinforced plastics body components made by conventional preform molding techniques, instrument panels, hard tops for metal bodies, and fenders led the list of applications in 1955. Other plastics materials also found growing application in the automotive field, as follows:

Rigid vinyl sheeting and rigid styrene copolymer sheeting formed into kick plates, dashboards, front seat side shields, arm rests, and other types of interior linings. Perhaps the most ambitious project of this type in the automotive industry is the use by Plymouth of formed styrene copolymer sheeting for lining the top of their two-door and

four-door 1956 line of station wagons.

Cushioning (for seats, doors, or dashboards) fabricated of vinyl or polyurethane foams (MPL, Sept. '55, p. 114). With current emphasis on safety in automobile design, "upholstered" resilient dashboards loom particularly large as a market for the foam material. Already in use in a number of '56 models were dashboard crash pads formed of resilient styrene copolymer sheet backed up with vinyl or polyurethane foam.

Coatings for exterior and interior surfaces. In 1955, as in previous years, nitrocellulose and alkyd lacquers captured the greatest share of this market, but considerable interest was expressed in the vinyl organosols as a possible coating material. One manufacturer introduced a textured organosol coating applied to the dashboard in '55 De Soto models (MPL, Nov. '55, p. 106).

## IN HOUSINGS

**L**ENDING weight to the large-volume markets that already exist for molded or fabricated plastics in the design of various types of housings are developments that took place in 1955 in three of the newer areas of application: 1) housings formed of vinyl-to-metal laminates; 2) housings formed of rigid plastic sheet; and 3) housings fabricated of reinforced plastics.

The vinyl-to-metal laminate, in

particular, combining as it does the beauty, abrasion resistance, and weather resistance of vinyl with the strength, rigidity, and formability of metal, made rapid strides forward. Since the early part of 1954, when the application was first announced, some 14 additional vinyl-to-metal laminators have moved into the business and more are coming in each month (MPL, June '55, p. 107) . . . and, reportedly, they are after

a share of the rich market in formed business machine housings.

From the standpoint of volume plastics usage, of even more importance was the announcement by one major business machine manufacturer that a technique had been perfected for laminating vinyl sheeting to reinforced plastics and then forming the combination into a lightweight, dent-resistant, corrosion-resistant, and attractive housing. At



Reinforced plastics panels for motor housing weight 1/10 as much as iron panels



Lightweight panels can be easily lifted by hand and fastened in place over the motor

the present time, the housing components based on this type of laminate are being produced on a pilot plant scale for only one model in the company's line of business machines, but other models are expected to be released for production in the near future (MPL, Dec. '55, p. 115).

Housings which are pressure or vacuum formed from rigid plastics sheet are also gaining top considera-

tion in the new product designs of leading manufacturers. In line with this trend, raw materials suppliers are emphasizing the production of tough, rigid sheet materials with glossy, porcelain-like finishes that fit into the appliance field, as well as the production of resilient sheet materials (particularly the styrene copolymers) that can provide protection for delicate instruments,

cameras, viewers, etc. New techniques for strengthening deep-drawn parts (including the use of a foamed-in-place isocyanate reinforcing bead in a thinned-out groove) are lending momentum to the trend (MPL, April '55, p. 87).

In the design of housings for machine tools, a marked swing was noted in 1955 toward a more extensive use of reinforced plastics. Typical of the many jobs done during the year is a motor housing for a vertical lathe. It consists of polyester-fibrous glass laminate panels buttoned into place over the motor (heavy metal panels previously used had to be bolted or hinged in place). By taking advantage of plastics tooling (in this case, epoxy-fibrous glass molds), the parts for the housing are produced at a savings in production costs of about 30 percent. The total weight of all the parts is approximately 37 lb.; the same panels in cast iron would weigh more than 300 lb.; if made of aluminum, about 120 pounds. Despite their light weight the plastics panels are extremely durable, require little maintenance, and are resistant to abrasion from metal chips or shavings.



## IN SIGNS AND DISPLAYS



Courtesy Auto-Vac Co.

Economies inherent in pre-printing plastic sheets and forming them in register promoted widespread use of technique

Courtesy Rohm & Haas Co.

Back-lighted translucent acrylic signs, as attractive by night as by day, also expanded in scope in 1955

**B**OTH indoors and outdoors, from small counter displays to huge "spectaculars," plastics materials in many forms made their presence strongly felt in 1955 in virtually every phase of the huge sign and display industry.

Volume-wise, the biggest future for plastics, on the basis of developments in 1955, appears to be in formed three-dimensional counter and window displays aimed at mass-market merchandising (MPL, Apr. '55, p. 87). Practically every major display house in the country was in the business to some degree; one of the largest of these (a lithographer with production runs in the hundreds of thousands of units) reported that formed displays already accounted for close to 10% of his total volume.

While most of the formed displays

that were created in 1955 were certainly bigger, more colorful, and more spectacular than ever before, they must also be rated as better engineered and more soundly designed than their predecessors (MPL, Nov. '55, p. 101). And new ways continued to crop up for improving them even further. Advances in metallizing plastics sheets and in the use of decals, for example, have opened new decorative possibilities. Several display manufacturers have come up with ideas for using formed transparencies (of

(To page 221)

Spectacular display consisting of translucent reinforced plastics panels supported by a steel framework stands close to 12 ft. high



Courtesy Rohm & Haas Co.

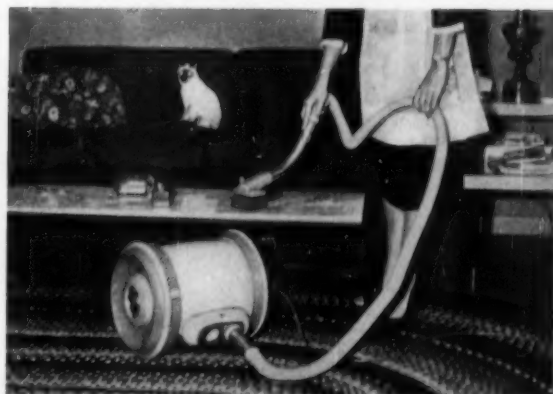
## IN APPLIANCES

**W**HILE established markets for plastics in the appliance field continued to grow at a steady, normal pace in 1955, refinements in processing techniques and the availability of tougher plastics materials were instrumental in opening up new and potentially large-volume areas of application. In many of these, plastics usage was virtually dictated by revolutionary changes in appliance design.

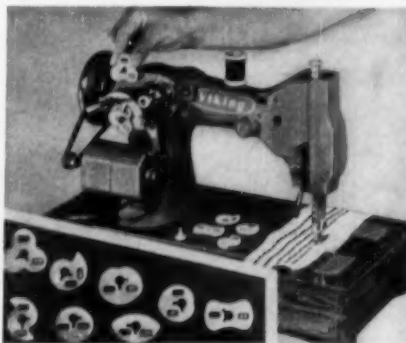
Two new vacuum cleaners which appeared on the market during the year, for example, by-passed the traditional upright design in favor of a more compact, easier-to-use tank-type construction—and plastics played a vital role in the success of both. One made good use of a new type of extruded vinyl hose capable of stretching from a normal free length of 6 ft. to an in-use length of 13 ft. without tearing (MPL, July '55, p. 93). The other, a rolling-type model, was mounted between two rubber-tired wheels molded of a tough new styrene-acrylonitrile-butadiene that had excellent impact resistance at high or low temperatures (MPL, Sept. '55, p. 104).

In the refrigeration industry, the general switch to inner door liners formed of styrene sheet dominated the year's activities, as it did in 1954. With the development of new techniques for forming more complex, intricately designed parts, however, a noticeable trend was evident in

Tank of new-type vacuum cleaner is mounted between rubber-tired wheels molded of a tough new styrene-acrylonitrile-butadiene blend



Courtesy General Electric Co.



Courtesy E. I. du Pont de Nemours & Co., Inc.  
Molded nylon cams (inset) are slipped into special device on sewing machine that directs movement of the needle

Courtesy Deepfreeze Appliance Div.,  
Motor Products Corp.

Styrene inner door liner for freezer unit is vacuum formed in one piece complete with integral shelf supports





Courtesy The Hoover Co.

Extruded vinyl hose for vacuum cleaner can stretch to 13 ft. without tearing

the production of one-piece formed parts with integral shelf supports and dispensing-type package racks (MPt, Feb. '55, p. 94). Intricate undercuts for door liners of this type were generally formed around "orphan" metal inserts pinned to the male mold or "hinged" inserts which collapse when the formed piece is lifted out of the mold (MPt, Apr. '55, p. 87).

New emphasis on molded reinforced plastics parts was also noted in the refrigeration field in 1955. One model refrigerator made extensive use of the material for structural parts, such as lock housings, drain stops, tie straps, latch hous-

ings, and striker mounting plates, which must not only resist stresses but must provide thermal insulation and freedom from corrosion (MPt, Oct. '55, p. 106).

Sewing machines have also found a novel use for plastics. Several of the models recently marketed are designed for automatic operation that enables even amateur home sewers to successfully use a wide range of decorative stitches. Key components in this automatic operation were molded plastics cams (either phenolic or nylon) which are inserted into special camming devices on the machine to direct the movement of the needle.



## IN SPORTING GOODS



Courtesy Owens-Corning Fiberglas Corp.

New golf club shaft is made of phenolic-impregnated glass cloth over steel



Courtesy Kimball Mfg. Co.

Woven cloth is molded as integral part of reinforced plastics water skis



Locking device for fastening reel to rod represents new nylon application

**R**ESIN-FIBROUS glass laminates, already familiar to American sportsmen in the form of fishing rods, archery bows and arrows, and snow skis, have now extended their sphere of activities into other phases of the profitable sporting goods market—thanks largely to the mass production economics made possible by improved molding techniques involving the use of matched metal molds.

Considerable sports interest, for example, was expressed in the lightweight, smooth-surfaced reinforced plastics water skis that can skim over the water at fast speeds. And to add a fashion note for the benefit of the ladies, one manufacturer introduced in 1955 a line of water skis in which a woven cloth (designed to match a popular bathing suit line) was molded into the skis as an integral part of the laminate structure (MPt, Nov. '55, p. 112).

Another item of sports interest was a disk-shaped sled also molded of reinforced plastics. Youngsters can sit comfortably—and safely—in the concave center of the saucer-like unit while sliding down snow-covered hills.

And still another innovation in reinforced plastics sporting goods in 1955 was a golf club shaft made of phenolic-impregnated fibrous glass cloth bonded to a thin steel core—

the most radical change in golf club design since steel replaced hickory a generation ago. According to the manufacturers, the shafts, by more completely absorbing vibration, eliminate shaft distortion or wobble and impart a softer feel throughout the swing.

It is interesting to note that two other applications for plastics in the design of golf clubs appeared in

1955—a strong indication that the market is not quite as unobtainable as most producers in the plastics industry had come to expect. One of these applications is an impact-surface insert for golf club faces which is fabricated of phenolic laminate (MPi, Oct. '55, p. 210); the other is a golf club head injection molded of a styrene-butadiene-acrylonitrile alloy (MPi, Sept. '55, p. 104).

In the design of fishing equipment, aside from the almost universal use of reinforced plastics rods, an interesting development in 1955 was the trend toward increased application of tough, corrosion-resistant nylon components in fishing reels (MPi, Aug. '55, p. 85). One of the newer applications along these lines in 1955 was a spinning-reel seat with molded-in locking grooves.

## IN ELECTRICAL AND ELECTRONIC EQUIPMENT

**A**CCOMPLISHMENTS in the field of production automation in 1955 were made possible to a large degree by advances in the use of plastics for the miniaturization of electrical and electronic equipment. Thanks particularly to the epoxies and to polyester film, many of the electrical devices introduced in 1955 could boast not only of being smaller and more compact than ever before, but of being more powerful and more efficient than their predecessors.

Plastics materials in this field were used in 1955 in three basic areas of application: for potting electrical equipment; as capacitor insulation; and in printed circuits.

In potting applications, improved resin formulations and an increasing awareness on the part of industry of the many advantages inherent in the technique were responsible for more widespread use.

One manufacturer of motors, generators, actuators, etc., for high-altitude aircraft, for example, reports that electrical characteristics of equipment potted in epoxy are unaffected by temperatures up to 250° F. and altitudes up to 65,000 feet. This same manufacturer has demonstrated that by potting many sub-assemblies together as a unit, fewer mounting straps, terminal blocks, rivets, and other hardware are necessary—reducing space requirements by about 50 percent.

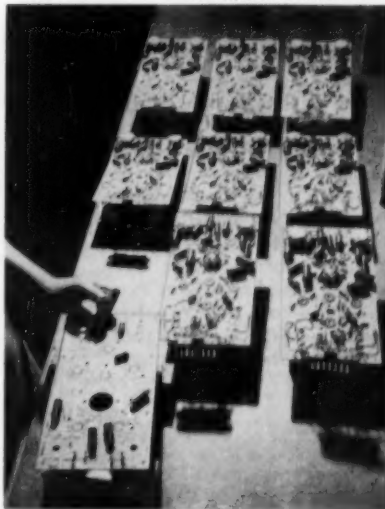
A basic result of this interest in epoxy potting compounds has been

(To page 223)

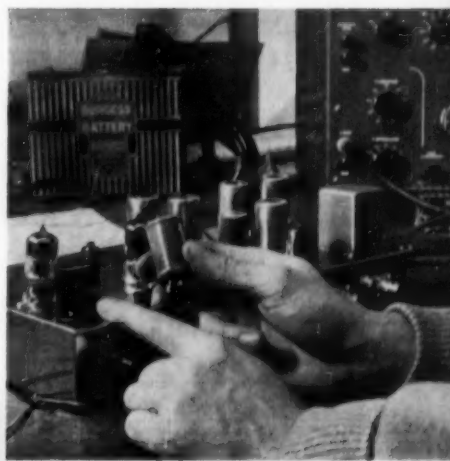
Small transformer potted in epoxy (mounted on chassis) is more compact yet more efficient than component previously used (held in hand)

Printed circuits on epoxy-fibrous glass laminate base facilitate automation of amplifier assembly line operation

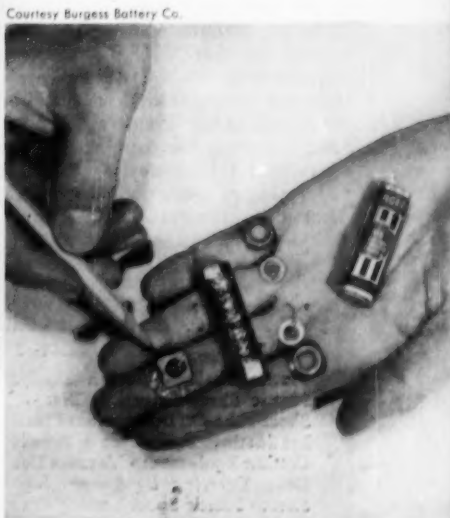
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## Engineering Progress in 1955

**T**HE year 1955 was the best the plastics industry has ever known. Not only did the molders, extruders, laminators, and fabricators enjoy prosperity, but the manufacturers of machinery, equipment, and materials shared in it as well.

This boom in plastics was only partly caused by the generally high economic level of all business. Much of the credit can be laid at the door of our own industry which, during the past 12 months, figuratively pulled itself up by its own bootstraps.

The reports carried during the year in the Plastics Engineering and New Machinery and Equipment sections of MODERN PLASTICS pointed up many of the advances in methods, techniques, and machinery which helped to bring about this upsurge in business.

The much wider use of automation, as exemplified by fully automatic molding (both compression and injection), was brought about not only by more fully automatic machines, but also by the greater emphasis which was placed on ingenious mold design. One of the big problems of automatic cycling of an injection machine is created by the runners. The growing use of hot-runner as well as runnerless molds not only has increased production, but also has gone far toward eliminating scrap. More and more is the molder coming to realize that a cheap mold will always be the least efficient and most costly in the long run.

Closer cooperation between molding, finishing, and inspection departments has increased production, raised quality, and at the same time reduced costs appreciably. This cooperation has been brought about because of the realization by top management that quality control is

practical and not just a theoretical tool for higher mathematicians only. Convincing the practical engineer that this system has a great deal of merit was not an easy task, but its use has spread in the plastics industry and, more important, has paid off handsomely during 1955. Even better results can be looked for next year.

Although the new high-density polyethylenes have not been available in sufficient volume during 1955 to make any significant impact on end products, their future potential is so great that much work has been done in developing the necessary methods for extruding, molding, and fabricating them.

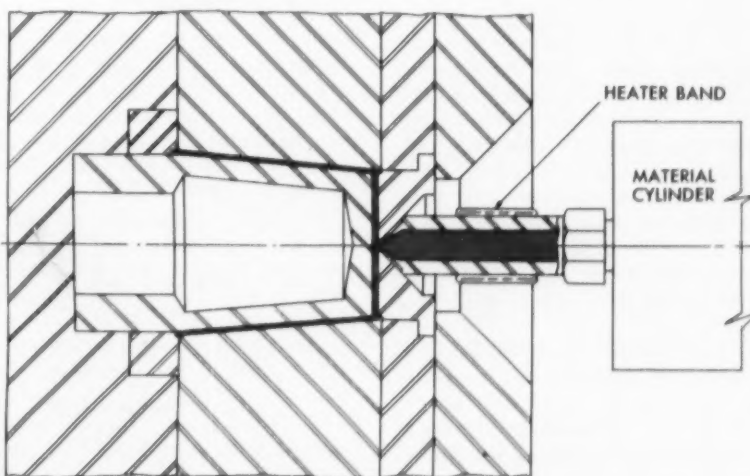
Not only have the material companies come up with new formulations and new materials, but work done in their laboratories has been of great help to the machinery manufacturers. Scientific studies of injection machine cylinders and torpedoes, as well as extruders, have resulted in a great increase of knowledge of machine operation

which leads to machine changes which increase speed and efficiency.

Some progress has been made in overcoming the cost problem in producing molded prototype samples. In many cases it is no longer necessary to make a metal mold in order to produce samples of the same material and having the same physical properties as are needed in the end product. Compression and injection molds have been made in less than two hours from a powdered metal-plastic mixture, which can be cast with fine detail and is strong enough to stand up under the pressures required in compression molding of high-impact phenolics.

The same results can also be obtained from matched-metal molded reinforced plastics by making the sample die from cast phenolic, molding the parts under the necessary pressure to get the required density, and then post curing in an oven.

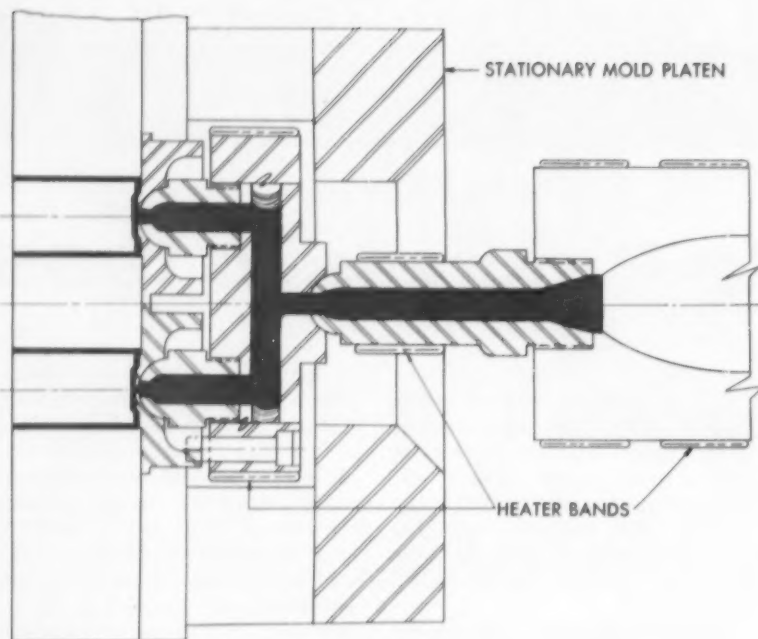
As the use of plastisols continues to rise, the trend seems to be toward the wider use of rotational equipment for casting. For example, full-



Courtesy Maslo Machinery Co.

Fig. 1—Runnerless injection molding, using a tapered nozzle (see p. 116)

\* Reg. U. S. Pat. Off.



Courtesy Moslo Machinery Co.

Fig. 2—Runnerless injection molding, using multiple nozzle with floating manifold

size duck decoys and mannikin heads are now being produced from a semi-rigid plastisol by this method.

## Molds and Molding

**Runnerless Molding**—The design of a successful hot-runner mold presents many problems, the answers to which still elude the majority of mold designers. Eliminating the runners entirely gives the molder all the advantages of a hot-runner mold with few of the disadvantages. An article in the April issue by Ernest P. Moslo, entitled "Runnerless Injection Molding," described several different methods by which runners have been eliminated. These include: 1) direct injection from a nozzle into a single-cavity mold, 2) direct injection from multiple nozzles into two or more cavities, and 3) design of center-gated phonograph record molds without runners. The article also detailed a successful design of a mold using hot or confined runners to multiple cavities.

Experimental work for the first method involved different nozzle designs aimed at eliminating or reducing to a minimum surface blemish and tendency for the material to freeze in the nozzle. The nozzle shown in Fig. 1, p. 115, gave the

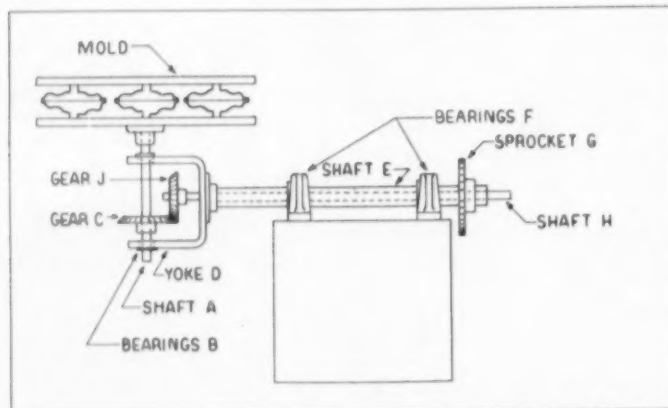
best results. The inside construction includes a straight bore  $\frac{1}{2}$  in. in diameter, reduced on a  $60^\circ$  included angle to an opening 0.030 to 0.040 in. in diameter. This is the gate into the cavity and the precise size of the opening will depend on the part to be produced. To reduce freezing with this nozzle, it is recommended that a part of the nozzle contact area with the mold should be relieved; in addition, nozzles made of beryllium copper were found more satisfactory than those made of tool steel. Accurate temperature control of the nozzle is of the utmost importance.

Several different approaches were made to the second method—direct injection from multiple nozzles—all of them being successful with certain advantages or disadvantages inherent in each. For example, when a heated manifold containing the nozzles is attached directly to the heating cylinder a very rigid assembly results, efficient and accurately controlled heating can be applied, and heat transfer to the mold is at a minimum. The main disadvantage is that special platens are required and mold design is limited to the nozzle spacing available in the platens.

Another approach to direct injection involves a standard heating cylinder and nozzle arrangement. However, the manifold is a floating member and the only contact between it and the mold is through the tips of the nozzles. Although the mold shown in Fig. 2, left, has four cavities, any practical number may be used. The manifold may be any shape desired. The main requirements are adequate heat with precise temperature control.

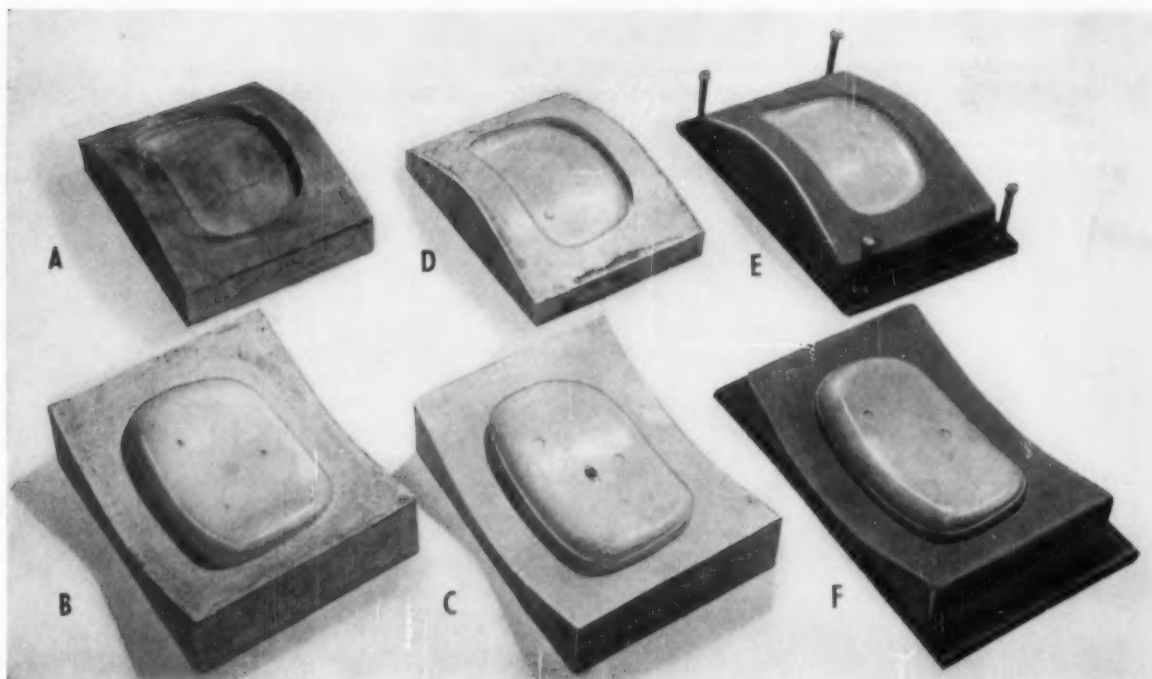
The third method—center gating for phonograph record molding—requires a nozzle having a hole the same size as the center hole in the record. Injection is from the nozzle through an opening of the same size into the cavity. After the passage and cavity have been filled, a punch is actuated from the movable platen side of the mold which not only pierces the center hole of the record but, continuing its movement, forces the entire slug of still hot material back into the injection nozzle.

Another design for molding rec-



Courtesy Reslac Chemicals, Inc.

Fig. 3—Mechanism produces compound motion for rotational molding (see p. 118)



Courtesy Duralastic Products Co.

Fig. 4—Male and female plaster patterns (A, B, C, and D) used to produce the two halves of a matched plastic mold (E—female, F—male). Details of the various steps involved in the actual mold-making operations are described in the text on p. 118

ords makes use of a special nozzle which acts as a core to make the center hole. Very tiny holes equally spaced around the periphery of the nozzle act as material passages for injection. The setup is so arranged that, as the clamp opens, the entire mold moves away from the nozzle, thus automatically shearing the tiny gates.

Two types of hot-runner molds were described, and correct and incorrect nozzle constructions were discussed. In conclusion, the author pointed out that in many cases the hot-nozzle, runnerless type, would be found generally more satisfactory.

**Mold Design**—An article by Wayne I. Pribble, "Engineering Mold Design," June issue, recommended certain steps which should be followed in engineering all molds. He showed how good parts drawings can help the mold designer and how good mold designer's drawings can help the mold maker. He enumerated the actual steps followed in designing and building a radio cabinet mold as an example of how all jobs of this nature should be done. A drawing of the required cabinet as

well as the mold drawings had points of importance indicated by arrows. Each point was numbered and the explanation in the text was keyed directly to each number.

In the August issue, Rudolph Lorenz, Jr., spelled out, step by step, the methods and materials used in making a most difficult single-cavity injection mold. This article, "Unusual Mold Design Produces Precision Moldings," told how it was necessary to explore several different methods of slot grinding before the mold could be produced with the very close tolerances required; for example,  $\pm 0.0001$  in. on slot width and  $\pm 0.0002$  in. on slot location. The successful production of this mold made it possible for I.B.M. to replace with one plastic molding an aluminum part which required 28 separate machine operations and 3 coats of insulating varnish.

**Plastisol Molding**—In the September issue an article, "Rotational Molding of Plastisols," by Samuel Zweig, brought up-to-date the techniques of the process and detailed recent developments in equipment. The author described the following

sequence of operation as now employed in the process:

1) A hollow, thin-walled sectional mold is charged with a measured amount of fluid plastisol and then closed.

2) The mold is rotated in a compound manner, such as about two axes, and, at the same time, is heated. The contained plastisol is forced against the interior surface of the mold by centrifugal force and, as the temperature of the material rises, it forms a gelled film on that surface.

3) Heating of the mold is continued until the gelled plastisol reaches the fusion temperature, which is generally about 350° F. At this temperature the vinyl acquires maximum tensile strength.

4) After the mold is cooled and opened, the finished article is removed. Then the mold is dried, making it ready for the next cycle.

He also put forth these advantages of rotational molding, compared with other methods of molding plasticized vinyl:

1) Accurate control of product weight is assured because a precise quantity of material can be dispensed into each mold cavity.

2) The operation requires less

floor space than comparable slush casting installations.

3) The operation is generally cleaner, conducive to lower labor costs, and subject to closer control of variables.

4) Scrap and reject rates have been found to be much lower than those experienced in other processes, particularly where the rotational casting process has been applied and operated with ample understanding of its technology.

Naturally, the process is limited to hollow articles, either completely enclosed or with a portion subsequently cut away. Otherwise, very few lim-

rotates in bearings F and is driven by a suitable sprocket or gear G, which is connected to a power source by meshing gears, chain, or belt. Bevel gear J is fixed to shaft H, which is contained within hollow shaft E and is held stationary by locking means at its opposite end.

The function of the mechanism can be visualized most easily by first considering the motion of the primary shaft E. As this hollow shaft is rotated, the entire assembly, except shaft H and its gear J, is swung in an arc about the axis of shaft E. As gear C swings about this vertical arc, the engagement of its teeth with

matched metal dies at 70 to 500 p.s.i. Lower glass content, lower filler loadings, and greater porosity generally characterize parts made by these techniques.

Molding pressures, type of pinch-off, surface effects, and formulations are comparable for both matched plastic and matched metal molding. The major difference in molding technique is that matched plastic die molding is carried out at room temperature and employs a post-cure at 250° F.

The procedure used in preparing chair-back samples illustrates this technique. The matched plastic tools were made using phenolic casting resins supplied by Reichhold Chemicals, Inc. First, a plaster model was made of the chair-back. The edge of this plaster model in its original form was unsuitable for the construction of a die for molding fibrous glass-reinforced plastics and, therefore, the edge of the model was first built up with sheet wax. This build-up created a proper shearing edge, which, in this case, constituted a vertical edge on the part. Such changes also resulted in improved rigidity of the molded part.

The step-by-step procedure in producing the phenolic dies for these chair-backs may be described as follows, the key letters in the description linking to Fig. 4, p. 117.

1) A plaster female (A) was taken off the model after it was revised by the addition of sheet wax to the edge as described above.

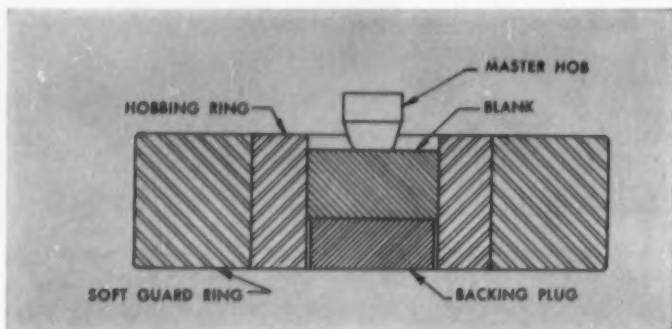
2) A plaster male pattern (B) was taken from the plaster cavity (A). This plaster male was the pattern against which the final phenolic cavity (E) was cast.

3) The plaster female (A), created as in step 1, was laid up with wax equal in thickness to that of the wall of the finished molded part.

4) A plaster male (C) was cast in the plaster female (A) after wax lay-up as in step 3.

5) A female plaster pattern (D) was cast against the plaster male (C) described in step 4. This female plaster is the pattern against which the final phenolic male half of the mold (F) was cast.

Thus there had been created a female plaster (A), a male plaster (B), and a set of plaster patterns, male and female (C and D), with part thickness clearance. The final phenolic dies (E and F) were cast



Courtesy Newark Die Hobbing and Casting Co.

Fig. 5—Diagram for mold-hobbing set-up shows positions of hobbing ring, master hob, hobbing blank, soft-steel guard ring, and backing plug (see p. 120)

itations exist as to shape and complexity. In addition, there are some shapes which cannot be otherwise economically formed.

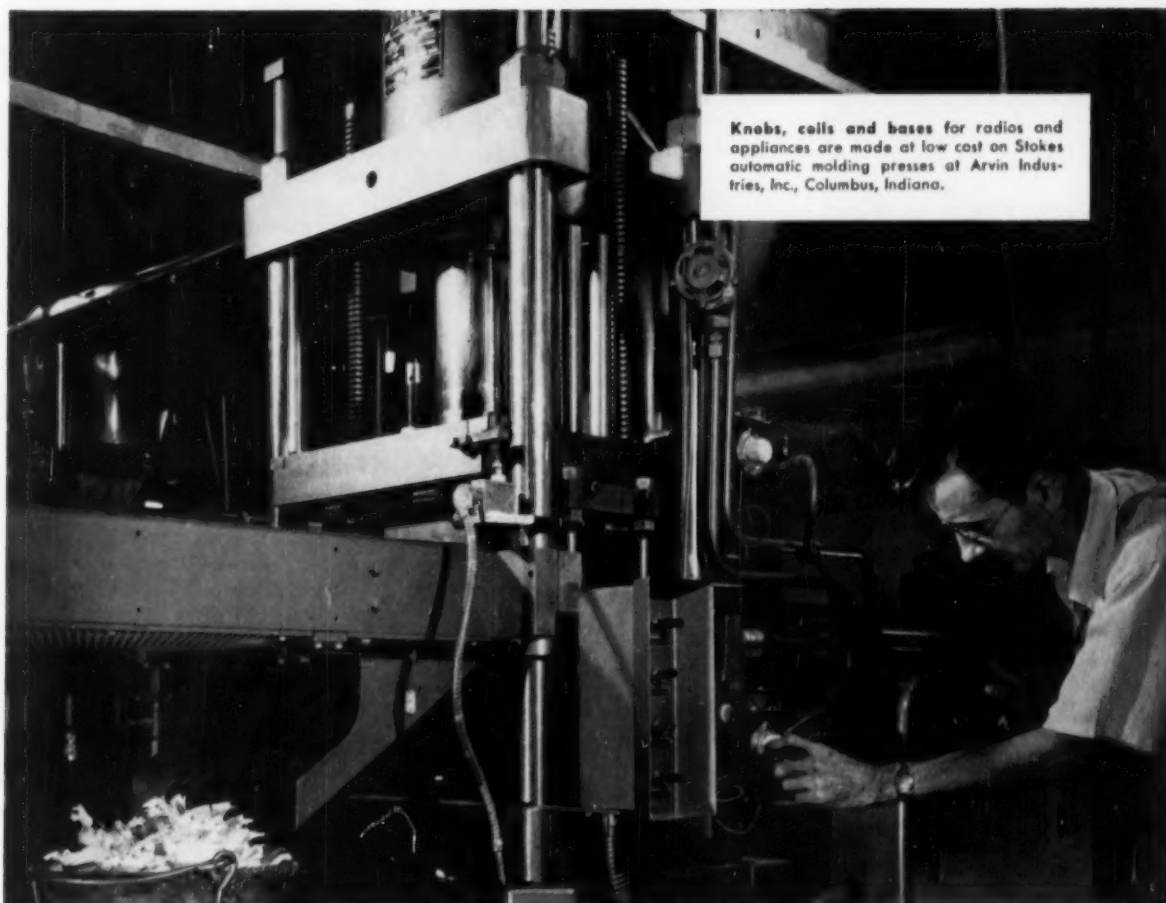
Rotational casting of vinyl articles offers further attractive features when compared to the molding techniques used with rubber. Assuming that a plastisol can be formulated to meet chemical and physical specifications, the immediate benefit is vast improvement in product appearance through high gloss and unlimited color availability. The capital requirements for equipment, molds, and related facilities are usually a small fraction of those needed for rubber molding operations.

The drawing (Fig. 3, p. 116) illustrates a typical means of achieving the compound motion necessary to rotational molding. The mold or cluster of molds is secured to the end of shaft A, which revolves in bearings B and is driven by bevel gear C. The bearings B are mounted in yoke D, which in turn is fixed rigidly to a hollow shaft E. The hollow shaft E

those of stationary gear J causes the secondary shaft A to rotate in a plane perpendicular to the plane of rotation about the primary shaft E. Centrifugal forces brought about by the resultant compound motion of the mold effectively distribute the plastisol on the interior surfaces of the molds.

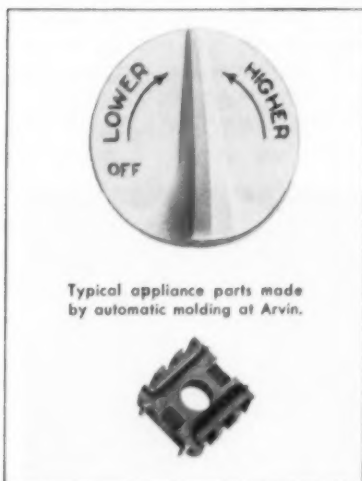
**Prototype Dies**—An article in the March issue entitled "Prototypes From Matched Plastics Dies," by Dr. J. N. Epel, described the Duralastic technique utilizing matched plastic dies for producing sample reinforced plastics parts which are equivalent to those produced in matched metal molds.

Pre-production samples of reinforced plastics parts have been made by hand lay-up (zero p.s.i.) and vacuum bag molding (14 p.s.i.) techniques. But parts produced by these methods cannot be classed as prototypes, since the physical properties obtained will not be equivalent to those of the final parts molded in



Knobs, cells and bases for radios and appliances are made at low cost on Stokes automatic molding presses at Arvin Industries, Inc., Columbus, Indiana.

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Stokes has had 20 years experience in

the design and application of presses for automatic molding. The latest achievement of this unequalled engineering background is a new rope feeding attachment on the 50-ton Model 741 for the automatic molding of glass-fiber reinforced polyester resins. Another recent Stokes modification of the Model 741 makes possible the automatic molding of coil forms and other parts with undercuts, affording molders vast new fields of opportunity.

You may be surprised at the cost advantages which lie in automatic molding. Send for Stokes revised brochure on Fully Automatic Injection and Compression Molding and Bulletin 525 describing the Models 741 and 800. F. J. Stokes Machine Co., Phila. 20, Pa.

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# STOKES



Courtesy Vacuum Sales Co.

Fig. 6—Metal is cast around cooling coils in forming mold (see p. 122)

dies is to cast the punch integral with steel mounting plates which have been prepared with anchor bolts and reinforcing rods for the purpose of providing a strong mechanical bond between the steel and the casting resin. The cavity is cast integral with a back-up plate and steel retainer frame.

The construction of the "pinch-off" determines whether non-porous molded parts are obtained. In matched plastic dies, the telescope must be a minimum of 0.100 in. and should be constructed with a clearance at the pinch-off of 0.004 to 0.010 inch. Closer clearance often results in broken edges, larger clearances in

"When and How to Hob," published in the February issue, the authors pointed out that hobbing has undergone no basic change since it was first developed in 1876 but that many basic improvements have been made in equipment and techniques.

Several variables must be considered before determining whether a certain cavity should be machined or hobbled. The number of cavities to be made, availability of equipment, necessary uniformity between cavities, and quality required in the finished article, must all be taken into account before a reasonable decision can be reached.

In some cases, the best procedure is a combination of machining and hobbing. At other times hobbing is the only satisfactory method of producing multiple cavities. This is particularly true when dies are being produced which have raised designs, numerals, or letters.

Because of the tremendous growth in demand for hobbled cavities of all shapes and sizes, hydraulic hobbing presses have increased in size and capacity from approximately 50 to 8000 tons.

Hobbing rings, or chases as they are sometimes called, support the soft hobbing blank and keep it from spreading away from the hob while under pressure. Hobbing rings, which are made of hardened chrome nickel steel, are generally supported on the outside by a soft steel guard ring as shown in Fig. 5, p. 118.

The hardened steel hob is so shaped that its form and dimensions (with allowances for shrinkage of the plastics material) are an exact duplicate of the plastic part to be



Courtesy Vacuum Sales Co.

Fig. 7—For fine reproduction, electroformed drupe mold is made from a female master, left, which in turn has been electroformed on original male model, right (see p. 122)

against the plaster patterns (B and D). The plasters (A and C) resulting from steps 1 and 4 were kept in reserve for major modifications which could not be made directly on the phenolic dies, should they be needed, or should a phenolic die be accidentally damaged.

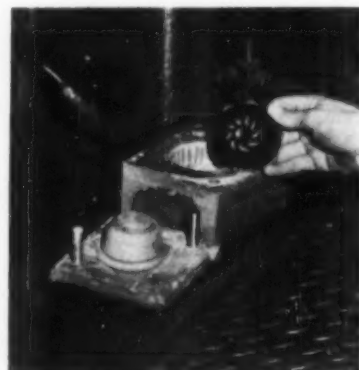
Matched plastic dies must be subjected to high molding pressures (70 to 300 p.s.i.) to obtain parts equivalent to those molded in matched metal dies. For parts of any appreciable depth, it is necessary to encase the plastic cavity in a rigid steel frame. For ease in handling and mounting on the press, it is desirable that both halves of the die be mounted on heavy steel plates. Experience has indicated that the most direct method of preparing plastic

too free a flow of resin so that a sufficiently high hydrostatic pressure cannot be built up within the die.

The dies are mounted in the press in the same manner as steel dies, with one important difference: the stops must be mounted external to the die, preferably on the mounting plates.

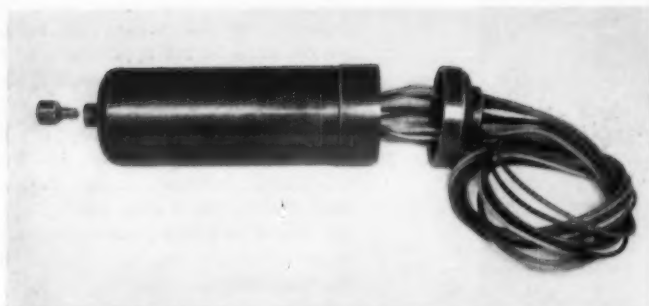
Matched plastic molding is carried out at room temperature. A two-stage catalyst system is used. Cobalt-Lupersol DDM is used for the room temperature cure within the plastic die; benzoyl peroxide is included to insure the attainment of full strength when the parts are post-baked in the oven at 250° F.

**Mold Hobbing**—In an article by Islyn Thomas and Edmund Spitzig,



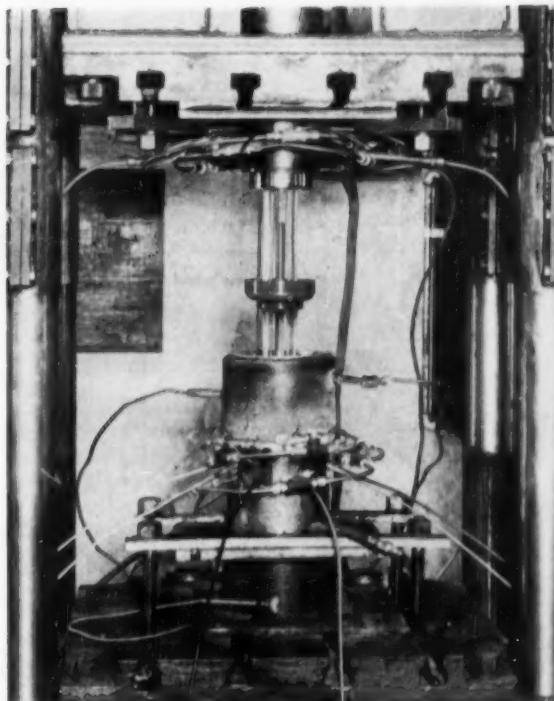
Courtesy Northern Industrial Chemical Co.

Fig. 8—Molded phenolic part is removed from mold produced from a special casting material (see p. 124)



Courtesy Western Electric Co., Inc.

Fig. 9—Parts of housing for electrical unit (l. to r.: sealing plug, bottle, and cap) are transfer molded of butyl-modified polyethylene material (see p. 126)



Courtesy DeBell & Richardson, Inc.

Fig. 10—Male and female halves of cap mold have holes to accommodate polyethylene-insulated wires that run through and are fused to cap (see p. 127)

molded in the cavities. The hobbled cavity is then a true negative replica of the hob. In cases where certain features of the article to be molded must be left off the master hob, the cavity is machined after hobbing.

While the design of mold cavity hobs varies from one shop to another, there are some fundamentals which should not vary. These include the incorporation of as many fillets as possible, elimination of sharp corners, use of maximum permissible taper or draft which should be a minimum of 0.005 in./in. per side, highly polished surfaces, and no undercuts.

In the selection of steel for the hob, machining characteristics, minimum distortion in hardening, depth of hardness, compression strength, and the combination of substantial hardness with toughness, must be considered. An oil-hardening chrome-tungsten-vanadium steel is well suited for the making of a hob and, if properly hardened to C-58 to 60 Rockwell and well polished, it will stand up under heavy hobbing pressure.

In order to retain dimensional accuracy of the hob, and long hob life, hobbing pressures should not exceed 145 to 160 tons per sq. in. for the hardest hob steels, and 110 to 120

tons per sq. in. for hob steels that are slightly softer.

Successful hobbing depends to a great extent upon the blanks. These blanks are made from special hobbing steels and are generally annealed before they are used.

Several types of steel have been developed for hobbled cavities. One is a low-carbon case-hardening steel with a maximum Brinell hardness of 100 which is used where ease of flow under pressure is required.

When greater toughness and resistance to upsetting is required, chrome nickel steels are used although greater difficulty will be encountered in the hobbing operation.

First step in the preparation of a hobbing blank is grinding and polishing to a mirror-like finish of the surface which comes in contact with the hob. Then, after being fitted to the hobbing ring, the blank is ready for the first push. To help reduce the power needed, some blanks are relieved by removing metal from the bottom. A good rule of thumb formula for sinking round cavities is to make the diameter of the blank approximately twice the diameter of the hob and blank height about twice the hobbled cavity depth.

After the hobbing ring is set in the press, the backing plug and the

already polished soft blank are placed inside it. The hob is then put in position over the blank, care being taken that all foreign matter is removed.

As the hob sinks into the blank, the operator watches the pressure gage. Ordinarily, the pressure rises to the maximum required for a particular hobbing and then remains nearly stationary while the hob continues to sink very slowly into the blank. This continuation of the hobbing operation at practically the same pressure indicates that the work is proceeding satisfactorily and that the metal is flowing around the hob. When the pressure rises rapidly it indicates that the hob has stopped sinking. Pressure should be released as soon as this condition is noted, to avoid damage to the hob.

A cavity may be hobbled in one operation but, if the blank offers too much resistance, due to the depth of the cavity, the hob should be removed and the blank annealed and possibly relieved. It may be necessary to repeat this operation several times.

The annealing process involves placing the cavities in steel containers packed with charcoal, sealing the cover with fire clay to exclude air, raising the temperature of the entire



Courtesy Steiner Plastics Mfg. Co., Inc.

Fig. 11—Final assembly operations on dictating machine carrying case formed of styrene copolymer sheet material proceed on production line basis (see p. 127)

unit to 1500° F., then allowing it to cool slowly in the furnace.

Pressures required for hobbing ordinarily range from 50 to 200 tons per sq. in. of die impression. The pressure varies not only according to the composition of the steel, but also with the method of hobbing. For instance, if the blank is confined by a chase ring, the pressure that is needed may be double that which would be required if the blank were unconfined.

Selection of hob steel is important. A water-hardening tool steel generally does not harden deep enough; oil-hardening tool steels are, therefore, recommended for use as for master hobs.

Hobbing requires a lot of experience to solve difficult tasks without prior tests. The real work and art is in producing deep cavities that must have the exact dimensions of the master hob.

On one-push impressions the amount and location of relief is extremely important. But it is on those impressions requiring two or more squeezes that the hobber's skill and

experience really comes into play.

Hobbing is not like a machine tool operation where the work is constantly in view. The results can be seen only when the hob is removed from the impression. It takes only a few seconds in a hydraulic press to ruin a hob on which many hours and dollars have been spent.

**Vacuum Forming Molds**—The article "Molds for Vacuum Forming," in the March issue, disclosed that no matter what material is used in such molds, their heat-conductive prop-

erties are of paramount importance. In production work, molds will gradually heat up as the forming operation continues from cycle to cycle if they are not cooled by some means, such as the application of a blast of cool air between each cycle or the use of a cooling medium circulated through suitable cores in the molds. Molds of wood, plaster, and plastic, however, do not tend to cool off sufficiently even when properly cored for cooling water, because these materials are such excellent heat insulators.

Molds of metal, however, when properly cored, will dissipate the heat rapidly. Most metal molds for vacuum forming are simply shells which are backed-up by some sort of cast material; coring for carrying coolant is a network of metal tubing inserted in this back-up.

If the back-up material is not a good heat conductor, the advantages gained by coring will be eliminated. A plastic or plaster backing of any kind is therefore not recommended.

Just recently the old and well proved electroforming method of reproducing a shape in metal has been applied to the production of vacuum forming molds. The process, essentially the same as that used in producing phonograph record stampers, consists of electroplating nickel and copper onto a model which can be made of wood, plaster, plastic, metal, or, in fact, practically anything that will not deteriorate when immersed in electroplating solutions.

In order to take full advantage of the excellent heat conductivity of the plated mold shell, the back-up material used is a low-melting-point metal which is cast into the mold (Figs. 6 and 7, p. 120) after the cooling coils have been located.

Such electroformed molds for use in vacuum forming are ideally

Table I—Physical Properties of Reinforced Abrasive Wheels (See p. 127)

Type of reinforcement	Bursting speed	Impact strength	Flexural strength
	surf. ft./min.	ft.-lb./in. <sup>2</sup>	p.s.i.
1. Non-reinforced	20,000	75	1000
2. Laminated	27,000	125	2000
3. Glass: Semi-rigid	30,000	300	5000
4. Glass: Very rigid	40,000	400	7000



Plastic pump of

## TENITE POLYETHYLENE



cuts material and  
fabrication costs...  
is strong, inert,  
corrosion-resisting

Two plastic moldings plus a small stainless steel shaft form this compact, efficient, long-lasting pump. It's a pump that cuts costs for both maker and user.

Inexpensively molded of Tenite Polyethylene, it is simple to fabricate, assemble and attach to an electric motor. Any waste material can be almost completely salvaged.

And because Tenite Polyethylene is so corrosion resisting and so inert, users solve many tough jobs with these tough pumps. On vending machines they are handling sensitive beverages without impairing delicate flavor, color or clarity. In washing machines and other household appliances, they are showing long life despite daily exposure to the corrosive attack of detergents, bleaches and alkali. In photo developing units these pumps are handling water, hypo and acid solutions without affecting sensitive photographic fluids or emulsions. In another application, they are handling anti-freeze at minus 80° F.

Do you have a job for a tough, useful plastic like Tenite Polyethylene? Perhaps one of your products could be given more sales appeal, better performance or longer life if it were made of Polyethylene. If so, make it of Tenite Polyethylene.

For advice and more information about this versatile plastic, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSFORT, TENNESSEE.

**TENITE**  
**POLYETHYLENE**  
*an Eastman plastic*

Pump manufactured by Gorman-Rupp Industries, Inc., Bellville, Ohio.  
Molding by Champion Molded Plastics, Inc., Bryan, Ohio.

adapted to long production runs. They have few limitations as to size and shape and produce formed parts with excellent surfaces. Fine detail can be held and production speed is not limited by thermal build-up in the molds themselves.

**Short Run Molds**—A. M. Creighton, Jr., in "Low-Cost Molds for

Short Runs," published in the November issue, described a new casting material for producing inexpensive compression and injection molds in a matter of a few hours, which now makes it possible to mold samples or to make short production runs at a fraction of the cost involved when machined molds are used. The material, known as Dev-

con C, is composed of approximately 80% powdered metal (aluminum and steel) and 20% specially compounded thermosetting resin. A powdered catalyst is used and final cure is achieved in an oven.

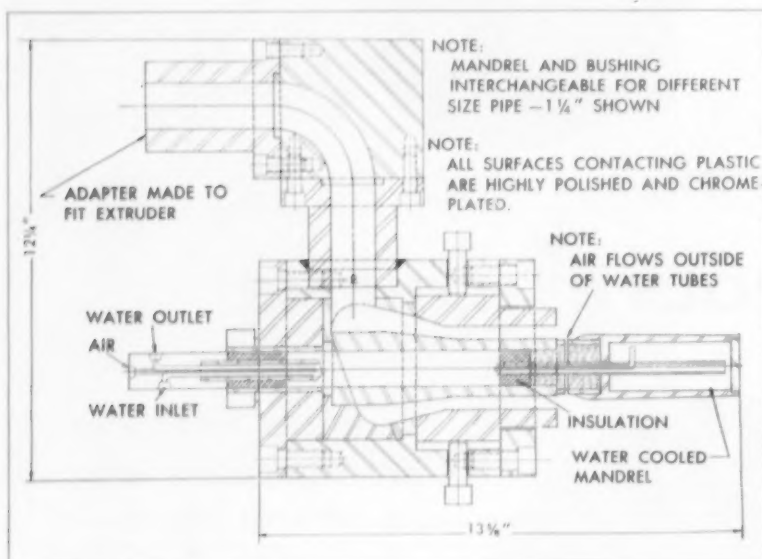
The finished die is neither as strong nor as hard as steel, but it is extremely tough; compressive strength is over 5000 p.s.i. at 400° F. Although heat transfer is not as good as that of steel, once the mold has been brought up to temperature it will hold its heat extremely well.

Once the material has hardened, it can be drilled, ground, threaded, or otherwise machined with standard metalworking tools.

The single-cavity mold in Fig. 8, p. 120, was used to produce a part from high-impact phenolic material. Mold temperature was 350° F. and molding pressure 10,000 p.s.i. The curing cycle was 3 minutes.

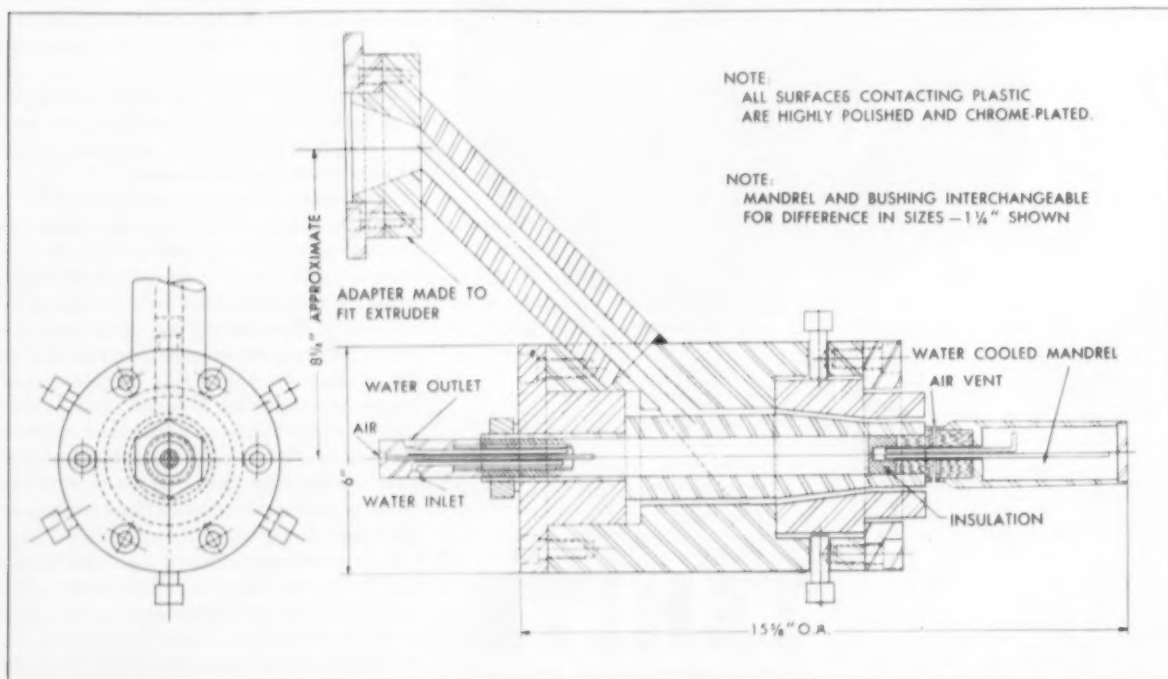
Total working time required for making the entire mold, not including the model, guide pins, or elapsed time for oven cure, was 1 hr. 50 minutes. The addition of the guide pins and one backing-up plate required approximately 3 hr. of additional work.

A four-cavity injection mold made of Devcon C, set up in a Van Dorn injection machine, was used for



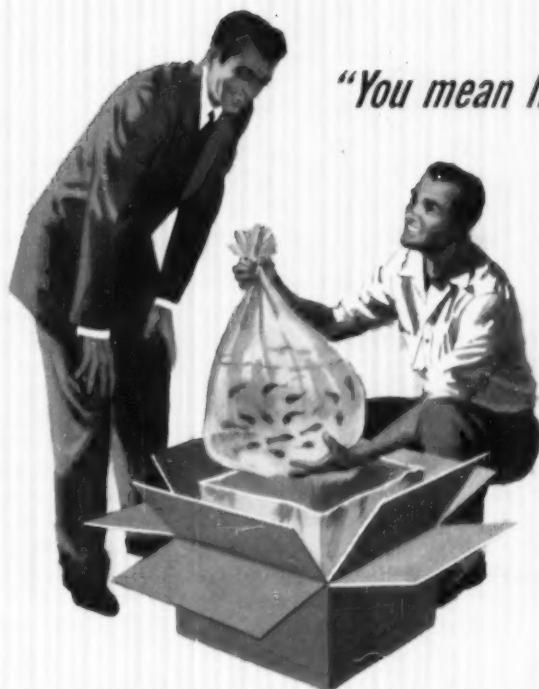
Courtesy Robbins Plastic Machinery Corp.

Fig. 12—Offset-type die for extruding polyethylene, styrene, and butyrate (see p. 120)



Courtesy Robbins Plastic Machinery Corp.

Fig. 13—Angular offset-type die used for the extrusion of flexible and rigid vinyl products (see p. 120)



*"You mean live fish?"*

Exactly: Live fish. In water.  
In a corrugated box.

A customer of ours uses this  
unique bag-in-a-box-in-a-box to ship  
live tropical fish all over the world.  
Says it's the most damage-proof  
and economical package he's used  
in 32 years as an aquarist.

Just goes to show you:  
Nothing's impossible for H&D  
Package Engineers. Why not let 'em  
tackle your packaging problem?



**HINDE & DAUCH**

AUTHORITY ON PACKAGING • SANDUSKY, OHIO  
13 FACTORIES • 40 SALES OFFICES

**Table II—Heat Sealing Capacity vs. Power and Vinyl Thickness (See p. 130)**

Power output kw.	Gage of sheet	Length of seal per 1/16 in. width			
		in.	in.	in.	in.
		0.008 in.	0.016 in.	0.032 in.	0.040 in.
1		18	20	25	30
2		38	48	55	65
2.9		60	70	80	90
4		90	100	115	125
5		105	125	135	150
6.5		120	150	165	185
8		135	175	200	235
10		175	225	275	325

molding small polystyrene parts. The working time required in making the cast sections of this mold was exactly 2 hours. Both the injection and compression molds were run at the Northern Industrial Chemical Co., which was responsible for much of the work on the early evaluation of this material.

Hans Wanders, vice president of Northern Industrial, states that through the use of Devcon C, "we will now be able to be of even greater

service to our customers when quick service runs are required."

Devcon C is not intended to replace presently used mold making materials. Rather, it will complement them by allowing quick and low-cost sample and short run production.

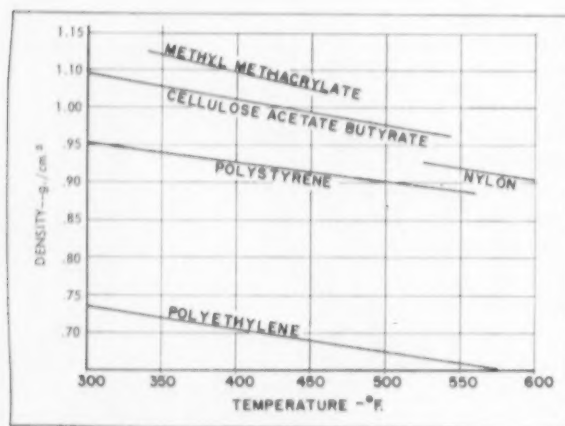
**Welding**—"Molding and Welding Polyethylene," by H. R. Bosworth, in the October issue, described an interesting combination of mold design, molding techniques, and plastic

welding procedures which is being used in producing a recently developed electrical unit for continued underwater use. (See Fig. 9, p. 121.)

The unit is sealed in a flexible polyethylene housing, consisting of three molded parts—a cap, or cover, which has eight polyethylene-insulated wires molded through it, with the insulation of each wire fused to the cap during molding; a bottle; and a sealing plug. All parts are made of a polyethylene compound containing 5% of butyl rubber which improves resistance to corrosion cracking but also introduces new molding and welding problems.

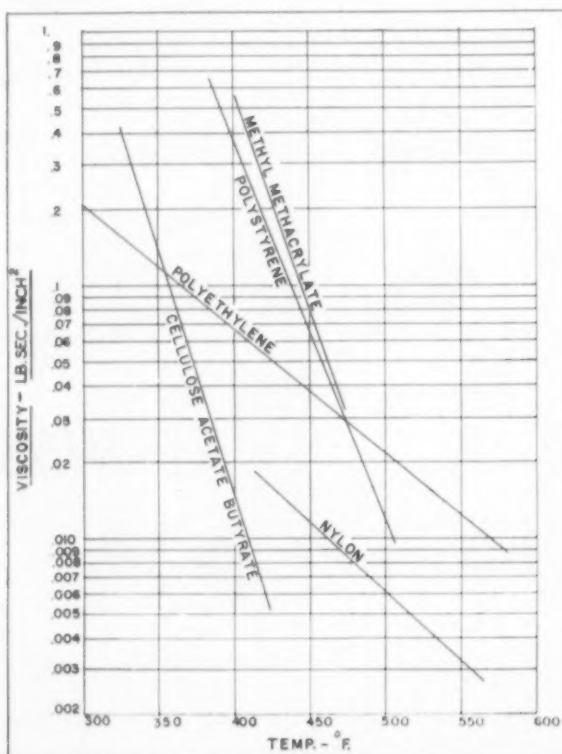
The cap and bottle are joined together by a welding operation similar to that used in making gas welds in steel. The plug is also sealed to the end of the bottle in like manner. The complete unit—bottle, cap, and plug—is about 13 in. long (not including the lead wires which extend 3 ft. beyond the cap), and 4 in. in diameter, with 1/4-in. wall thickness.

Because of the butyl rubber in the compound, it was found impossible to injection mold the parts satisfactorily. Accordingly, it was necessary to mold them in a Bolling transfer press. The material is preplasticized in a 1 1/2-in. extruder, the extruder



(Illustrations courtesy Du Pont)

**Fig. 14—Graph showing melt densities of several plastics over a range of temperatures. The Simplified Extruder Flow Equation gives output figures in volumetric units. The above plot aids in converting these figures to gravimetric terms, which are more commonly used (see Tables III and IV on facing page and text on p. 130)**



**Fig. 15—Extrusion viscosities for melts of several plastics over a range of temperatures (see Tables III and IV, also text on p. 130)**

**Table III—Conversion Factors**  
(See p. 130)

*Helix Angle*

The helix angle ( $\varphi$ ) is related to the lead ( $t$ ) and the diameter ( $D$ ) of the screw, as shown in the formula:

$$t = \pi D \tan \varphi$$

If lead = diameter, then

$$\varphi = 17.8^\circ, \text{ and}$$

$$\sin 17.8^\circ = 0.306$$

$$\cos 17.8^\circ = 0.952$$

*Viscosities*

$$10^6 \text{ poises} = 0.145 \text{ lb. sec./in.}^2$$

Some approximate extrusion viscosities are given in Fig. 15, p. 126.

*Densities*

To convert the volumetric output figures obtained from the Simplified Extruder Flow Equation into gravimetric units, the densities of polymer melts shown in Fig. 14, p. 126, are needed.

being run at intervals for the length of time necessary to deliver a charge of the correct weight. This charge of hot material is immediately placed in the pot and transferred into a hot mold. The heat is held in the mold until complete fusion is obtained and the stresses are relieved, after which it is cooled with circulating water.

The cap mold (Fig. 10, p. 121) is special in that the polyethylene-insulated lead wires must be threaded through the mold and come out both top and bottom. When the mold is heated, the polyethylene-covered wires must be kept cool with individual cooling coils so that the coating will not melt and be forced out or distorted by the molding material under pressure; at the same time, the cooling must be limited so that the wire insulation will bond to the molded cap at the mold face. The mold is cycled for about 8 min. under steam pressure of 20 p.s.i., after which the steam is turned off and cooling water is circulated in the mold for 5 minutes.

The bottle is molded in much the same manner except that there is no problem with wires.

In joining polyethylene parts by welding, accepted practice is to bevel the edges of the parts to be joined so that a V-notch is formed when the two edges are placed together. The notch is then filled, using a polyethylene welding rod and applying heat so that the surfaces become plastic enough to flow together into a welded seam. An electrically

heated torch with a small nozzle directs a jet of hot gas upon the surfaces to be joined together. Nitrogen fed through the torch prevents oxidation; oxidized surfaces cannot be satisfactorily welded. Because of the butyl rubber in the polyethylene, in this case, it is necessary to use more care in order to produce an acceptable weld than when polyethylene is used alone.

After completion of the welding operation, the excess material is removed by a special cutting tool.

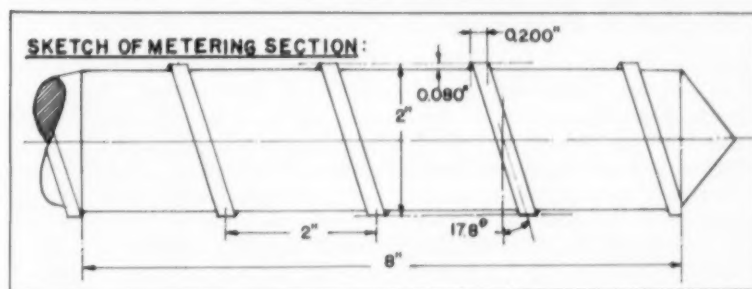
**Dictating Machine Case**—"Engineering a New Case," in the July issue, described the evolution of a new lightweight carrying case for Dictaphone's portable dictating machine. (See Fig. 11, p. 122.) Making the case of styrene copolymer sheet not only reduced the weight by over half, but also made possible the production of a smaller case with greater eye appeal.

The article gave details of the complete forming process and revealed certain unique methods which made the manufacture of the machine case possible.

**Super Insulators**—The methods used to mold styrene insulators of superior quality for use in radiation detecting devices were detailed by H. R. Broadley in "Molding Styrene Super Insulators," published in March. The special equipment necessary to obtain the carefully controlled conditions so necessary for this job was described.

**Grinding Wheels**—"Reinforced Abrasives," by P. L. Shanta, in the September issue, described the methods used in molding the latest types of reinforced grinding wheels. The use of felted cellulosic fiber grain-included and fibrous glass fabrics for laminated wheels now makes them safer to operate, increases their util-

**Table IV—Sample Calculation (See p. 130)**



*Operating conditions:*

Screw speed: 90 r.p.m.

Material: Polyethylene

Die pressure: 600 p.s.i.

Stock temperature die: 435° F.

Stock viscosity: 0.045 lb. sec./in.<sup>2</sup>

*Values for terms in the flow equation:*

$D = 2$  in.

$N = 1.5$  r.p.s.

$\cos \varphi = 0.952$

$h = 0.080$  in.

$\varphi = 17.8^\circ$

$\mu = 0.045$  lb. sec./in.<sup>2</sup>

$L = 8$  in.

$\sin \varphi = 0.306$

$P = 600$  p.s.i.

*Calculation:*

$$Q = \frac{(\pi)^2 (2)^2 (1.5) (0.080) (0.306) (0.952)}{2} - \frac{(\pi) (2) (0.080)^2 (0.306)^2 (600)}{(12) (0.045) (8)}$$

$$Q = 0.69 - 0.04$$

$$Q = 0.65 \text{ in.}^3/\text{sec.}$$

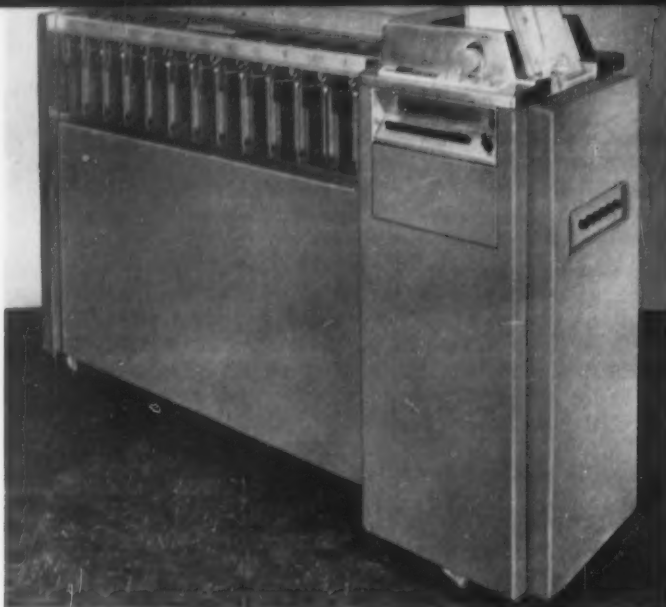
Density of polyethylene at 435° F. is approximately 0.74 g./cm.<sup>3</sup>

$$\left( \frac{0.65 \text{ in.}^3}{\text{sec.}} \right) \left( \frac{16.4 \text{ cm.}^3}{\text{in.}^3} \right) \left( \frac{0.74 \text{ g.}}{\text{cm.}^3} \right) \left( \frac{3600 \text{ sec.}}{\text{hr.}} \right) \left( \frac{1 \text{ lb.}}{454 \text{ g.}} \right) = 62.5 \text{ lb./hr.}$$

*Conclusions:*

1) Screw should put out 62.5 lb./hr. at 90 r.p.m.

2) Operation should be relatively insensitive to back pressure. Back flow was only 0.04 in.<sup>3</sup>/sec. in output of 0.65 in.<sup>3</sup>/sec. or only about 6%. Therefore the die restriction should have little influence on output.



Courtesy International Business Machines Corp.

Fig. 16—Lightweight, rugged covers for high-speed card sorting machine are based on laminate construction of vinyl sheet bonded to reinforced plastics (see p. 225)

ity, and improves their performance. The comparative figures in Table I, p. 122, graphically illustrate these improved properties.

## Studies of Machinery

**Injection Cylinders**—A three-part article entitled "Temperature and Pressure Measurements in the Injection Machine Heating Cylinder," published in April, May, and June, was a report on many months of investigative work which the authors carried on in the Plastics Basic Research Laboratory of The Dow Chemical Co. The first section outlined the studies which were made to develop tests that would accurately measure the plastic temperature and pressure at the nozzle of the heating cylinder. The second paper noted that there was a great need for making quantitative meas-

urements on the heating cylinder of an injection machine and that the simplest and most direct method was to measure the temperature of the plastic. The authors then outlined a method for making such measurements conveniently and detailed some experimental results obtained by their method. The paper also discussed the flow characteristics found with various heating cylinders. The third section gave some practical conclusions about heating cylinder design which were based on the results of the research work described in the first two sections. These conclusions were as follows:

- 1) The chamber should have adequate plasticizing capacity, i.e., the ability to produce uniformly heated plastic at well above the maximum production capacity of the machine.
- 2) This plasticization should require a minimum of pressure loss.

3) The construction of the chamber should be leakproof and strong, yet it should be demountable for easy cleaning.

4) The flow path through the chamber should be smooth, with no dead spots. The surfaces should be uniformly heated to assure fast plasticizing without overheating.

The authors also pointed out that these conditions are, of course, difficult to achieve because design features which improve heating capacity usually increase pressure loss, and those designs which are most leakproof are welded and, therefore, difficult to disassemble. They noted, however, that heating chamber design is not all compromise and that it is possible to improve performance without sacrificing desirable qualities. The balance of the paper discussed the design factors which affect performance from the aspect of plasticizing capacity and pressure loss.

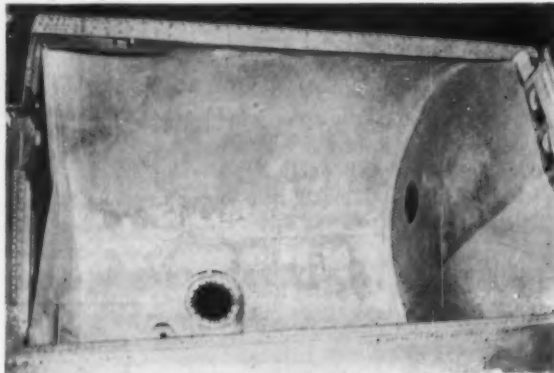
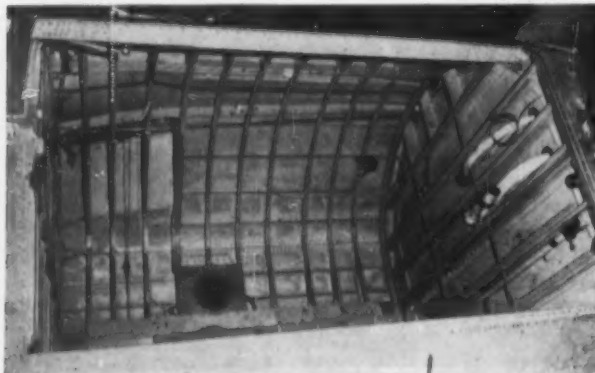
**Extrusion**—In an article, "Extrusion Dies and Take-Off Equipment," by Kenneth O. Robbins, published in December, the author pointed out that there is little if any "know-how" in the literature upon which to base the design of much of the specialized equipment which is required in an extrusion plant. He also pointed out that there are no exact formulas available for extrusion die design and stated that most dies built today are designed largely on an empirical basis.

The article contained two engineering drawings of offset dies. The first was recommended for producing polyethylene pipe or thin wall tubing, thin or heavy wall polystyrene tubing, and thin butyrate tubing and pipe (Fig. 12, p. 124); the second was for flexible and rigid vinyl products (Fig. 13, p. 124). In

Fig. 17—Two views of one of the two compartments that are used on the F9F Cougar to carry its self-sealing fuel cells. Left photo shows

the compartment unlined; photo at right shows it with side and bottom parts of reinforced plastics liner in position (see p. 226)

Courtesy Grumman Aircraft Engineering Corp.



# How papers by Mosinee make products safer, more efficient

*From cooling rooms to heating homes or guarding electrical apparatus — Mosinee specially developed papers help do the job better.*

**I**N these and hundreds of other cases involving insulation, fabrication, lamination, processing or packaging — Mosinee papers play an important part in getting optimum results with minimum trouble and expense.

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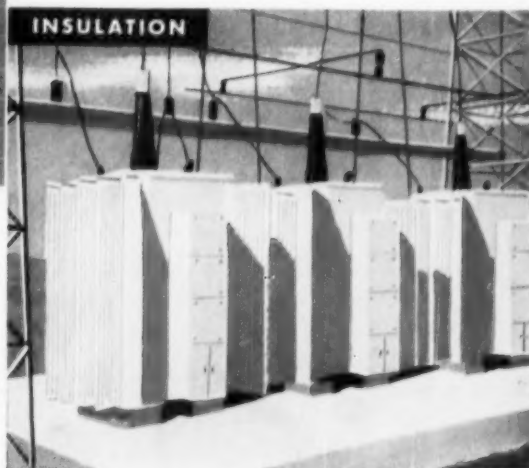
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makes fibers work for industry.*



**Evaporative cooler pads for room coolers are made from Mosinee controlled paper.**

A high rate of moisture absorption with wet strength are two of the critical properties of this highly specialized paper. In addition, this paper must be adapted to easy slitting and expanding in the conversion operation for pad construction. Here's typical Mosinee precision control at work.



**Special analysis Mosinee papers improve performance of electrical components.**

These electrical insulation papers must be closely controlled to provide a low ash and chloride content. They are used extensively as layer insulation between turns of field coils and in transformers — from the smallest to one of world's largest. Ask about Mosinee papers for your electrical requirements.

the first, the material passes through a curved 90° bend, goes to the die, and then moves through a special flow chamber which is radiused and angled to get even flow around all sides of the mandrel. The second is an angular offset die in which the material travels in a straight line at a 45° angle from the extruder adapter to the die. This die has a low-volume chamber through which the material travels at a high velocity and a comparatively low pressure so that the material will move fast enough to prevent burning.

The article also contained die design formulas for a gasket with a cushion, a shape with a bulb or heavy section, a U-shaped or gasket-type section with non-uniform walls, as well as a non-uniform-walled T-section. The author also discussed the differences in the formulas which would be required for different thermoplastic materials. In addition, certain auxiliary extrusion equipment was discussed.

**Heat Sealers**—In the article "How to Rate Electronic Heat Sealers," published in June, Philip Weiss showed how conventional square inch readings can be misleading and recommended that a more realistic basis would be linear inches of conventional 1/16 in. wide seal. The author proved his point by using an

8- by 2-in. die powered by a 2-kw. heat sealing unit as an example and getting a perfect seal. However, when a die having the same number of square inches (but 256 in. long by 1/16 in. wide) was used on the same sealer, an unsatisfactory seal resulted. The author pointed out that the basic reason for the reduction in sealing effectiveness that occurs as the length of the die increases and the width decreases is the phenomenon known as "die loss."

The author compiled Table II, p. 126, from research and experience and recommends that these data be used by manufacturers of electronic heat sealers rather than the fallacious square inch method now so commonly in use.

**Extruder Performance**—Steps followed in arriving at a simplified equation with which extruder flow can be calculated within an accuracy of ±15% were discussed in "Calculating Extruder Performance," by Ernest C. Bernhardt, February issue.

This equation is

$$Q = \frac{\pi^2 D^2 N h \sin \phi \cos \phi}{2} - \frac{\pi D h^3 P \sin^2 \phi}{12 \mu L}$$

in which Q=output in cu. in. per sec.; D=screw diameter in in.; N=screw speed in r.p.s.; h=channel

depth in in.; L=length of metering section in in.; φ=helix angle in degrees; P=pressure at die in p.s.i.g.; μ=melt viscosity in lb./sec./sq. inch.

This Simplified Extruder Flow Equation will give output figures in volumetric units. Since gravimetric units are usually preferred in practical applications, a plot is presented (Fig. 14, p. 126) showing the melt densities of several plastic materials over a range of temperatures.

Typical values for the die pressures (P) range between 200 and 1000 p.s.i. However, the actual back pressures can be considerably above those values in operations where screen packs are used. Accurate determinations of stock pressure may be made by using stock pressure gages.

Figure 15, p. 126, shows a plot of extrusion viscosities versus temperature for several plastic melts.

The most useful conversion factors are summarized in Table III, p. 127, and a sample calculation using the Simplified Extruder Flow Equation is given in Table IV, p. 127.

## Handling Polyethylene

In "The New Polyethylenes and Their Impact on Fabricated Parts," by Dr. J. A. Neumann and F. J. Bockhoff, published in August, were described the two different processes for producing the new types of high-molecular-weight polyethylenes: 1) by the Phillips method and 2) by the method developed by Karl Ziegler in Germany. The authors also compared the improved properties of the new polyethylenes with those of the more familiar type. They pointed out that not only does the new polyethylene material mold and extrude beautifully, but, in addition, that it can be successfully welded with weld strengths of at least 80% in practically all cases and as high as 100% of the parent material strength in exceptional cases.

They outlined the excellent application potentials and stated that these new polyethylenes introduce a completely new concept in plastic materials of construction. It was also pointed out that the new materials have higher rigidity, good temperature resistance, high impact strength, and extremely good chemical resistance. Thus they may well replace many of today's more expensive ma-

(To page 225)



Courtesy White, Inc. and Marion Molding Corp.

Fig. 18—Member of quality control staff, using pre-control gaging technique, makes in-process inspection of compression molded piece to check on the operation (see p. 226)

# S.P.E. Technical Conference

Program of 12th annual meeting, to be held in Cleveland

January 18-20, 1956, plus abstracts of papers to be presented

**T**HE 12th Annual Technical Conference of the Society of Plastics Engineers, Inc., will be held January 18, 19, and 20, 1956 at the Statler Hotel, Cleveland, Ohio, the keynote to be "Plastics Progress Presents."

## Program of Sessions

According to the advance program issued by the society, registration will begin at 1:00 P.M. on Tuesday, January 17, and will continue to Friday noon. Technical sessions will be held Wednesday, Thursday, and Friday mornings, as well as Wednesday and Thursday afternoons. The advance summary of these sessions is as follows:

**Wednesday, January 18, 9:30 A.M. to 12:00 noon.** Three simultaneous sessions: injection molding; epoxy resins; properties of plastics.

**Wednesday, 2:30 to 4:30 P.M.** Three simultaneous sessions: molding and extrusion; thermoplastic sheet; research.

**Thursday, January 19, 9:00 A.M. to 12:00 noon.** Three simultaneous sessions: extrusion; calendering and coating; reinforcement of plastics.

**Thursday, 2:00 to 5:00 P.M.** Three simultaneous sessions: plastic foams; plastic pipe; reinforced plastics.

**Friday, January 20, 9:00 A.M. to 12:00 noon.** Three simultaneous sessions: materials; design; education.

In addition to these sessions, there will be informal "bull sessions" as follows: Wednesday, 4:45 P.M., on injection and compression molding; Thursday, 4:45 P.M., on extrusion.

## Business Meeting; Banquet

The annual business meeting will be held simultaneously with the luncheon at 12:00 noon on January 18. Following the business meeting, the first public showing of the Du Pont Polychemicals Sales Service Laboratory will be presented by closed circuit television direct from Wilmington, Del.

On Thursday, January 19, at 6:00 P.M., a cocktail party and president's

reception will be held, followed by the banquet at 7:00 P.M. The banquet speaker will be Tennyson Guyer.

## Abstracts of Papers

Available abstracts of the papers to be presented at the sessions listed above are presented in the following paragraphs, grouped according to session subjects.

## INJECTION MOLDING SESSION

*Moderator, Gordon Thayer, The Dow Chemical Co.*

**A New Measure of Plastic Moldability**, by D. B. Semeyn, *The Dow Chemical Co.* This paper deals initially with the problems of moldability and methods of measuring, followed by a description of a specially designed mold, molding cycle, and unit of measure to more precisely define characteristics of moldability.

**Internal Fin-Type Heating Cylinder**, by Mario Maccaferri, *Mastro Plastics Corp.* and R. B. McKee, *The Dow Chemical Co.* Having no internal spreader, this heating cylinder depends upon internal fins for heat transfer surfaces and forces the melted plastic through small holes into longitudinal grooves which direct it toward the nozzle. Two tested designs and one in progress are discussed. A brief summary of heating test results is given and dimensional accuracy and heat distortion resistance of molded articles is compared to that of similar articles molded with heating cylinders of conventional design.

**Inside the Injection Mold With Polyethylene**, by R. W. Miler, C. E. Beyer, and M. Q. Tessin, *The Dow Chemical Co.* By means of a specially constructed glass-sided mold, the flow characteristics of polyethylene during injection molding are demonstrated to provide a better understanding of plastic flow, jetting, cooling, shrinkage, sink marks, etc.

Various phases of molding are shown in a motion picture.

**Automatic Molding**, by Donald H. Lewis, *Packard Electric Div., General Motors Corp.* The problems of automatic molding of thermoplastic wiring harness terminal insulators and recommendations for molding of other parts, based on production experience, are elaborated.

**Standardization of Injection Molding Equipment**, by A. J. DeMatteo, *Watson-Stillman Co.* This report describes the objectives of the standardization program and the standards themselves as written by the committee of injection molding machine manufacturers under auspices of the S.P.E. in cooperation with the Master Mechanics Committee of General Motors Corp.

## EPOXY RESIN SYMPOSIUM

*Moderator, F. S. Swackhamer, Shell Chemical Corp.*

**Development of an Epoxy Resin Potting Compound and Potting Mold**, by William H. Crandell, *F. S. Bacon Laboratories.* Epoxy resins, fillers, and hardeners in various formulas are discussed in relationship to the problem of producing compound and mold for precision pottings.

**Electrical Applications for Epoxy Resins**, by Dr. H. Rudoff and A. J. Rzeszutarski, *General Electric Co.* (Abstract not available at time of going to press.)

**Reinforced Epoxy Pipe**, by D. Boggs, *Fibercast Corp.* The long-term strength properties are related to environmental effects on tensile strengths, elastomeric characteristics, etc. Descriptions are given of testing procedures.

**Epoxy-Base Adhesives in the Aircraft Industry**, by W. Bandaruk, *Convair.* The use and development of epoxy resins and combinations of

resins for effecting durable, high strength bonds as metal-to-metal and metal-to-core adhesives are discussed.

**Epoxy Resins in Plastic Tooling**, by L. R. Sparrow, Republic Aviation Corp. The advantages and disadvantages of epoxy resins in plastic tooling are presented. The effectiveness of various epoxy formulations and methods of tool manufacture are evaluated from a practical engineering viewpoint.

## PROPERTIES OF PLASTICS

**Moderator**, Louis F. Rahm, Princeton University.

**Effect of Explosions on Plastics**, by H. A. Perry, Jr., U. S. Naval Ordnance. Test specimens molded in conical form are studied as to fracture, flow, energy absorption, and transmission of shock waves when subjected to explosive shocks. Effects of types and methods of reinforcement are discussed.

**Determination of Fracture Temperature of Embedment Castings**, by L. S. Buchoff, Westinghouse Electric Corp. A method for the determination of thermal shock resistance of embedment castings is described.

**Service Temperature Characteristics of Thermoplastics**, by J. J. Gouza and E. N. Robertson, Rohm & Haas Co. Data on strength properties versus temperature and modulus of elasticity versus time and temperature are presented for two acrylic compositions as per ASTM D988-48T Grades 6 and 8. The influence of molded-in stresses and their effect on crazing resistance are discussed.

**Irradiation of Plastics**, by D. S. Ballantine, Brookhaven National Laboratory. The effects of radiation on polystyrene, nylon, acrylic, polyethylene, and other plastics are discussed, with particular references to the effects on polyethylene. A variety of graft copolymers has been produced by the irradiation of polymers in the presence of a monomer.

**The Utility of Impact Testing as a Criterion of Toughness**, by C. H. Adams, G. B. Jackson, and R. A. McCarthy, Monsanto Chemical Co. The discussion includes limitations of accepted evaluation techniques used to estimate toughness of styrene-rub-

ber molding materials. Using a variety of shock-loading techniques, a more meaningful test has been developed, wherein impact is accurately measured and related to performance.

## MOLDING AND EXTRUSION SESSION

**Moderator**, J. H. DuBois, Micallex Corp.

**Compression and Transfer Molding of Guided Missile Parts**, by L. B. Keller and W. R. McGlone, Hughes Aircraft Co. Molding techniques are described for developing plastics missile parts that can meet rigorous aerodynamic and electrical property requirements, even after lengthy storage under severe environmental conditions.

**The Effect of Heat Treatment on the Polishability of Mold Steel**, by E. E. Lull, Crucible Steel Co. A report on investigations of mold steels indicates that good polishability is related to the absence of retained austenite.

**Engineering of Purchased Molds**, by J. C. O'Brien, Shaw Insulator Co. Ways and means are suggested whereby the molder and mold supplier can cooperate to improve product quality and promote good business practice.

**Cast-in Heaters**, by W. H. Norton, Thermel, Inc. Advantages of cast-in electric heaters for extrusion equipment are pointed out with relationship to the extrusion of a number of plastics. Factors are considered which dictated the conversion of other forms of heating to electric cast heaters.

**Stepless and Three-Position Temperature Controls on Extrusion Equipment**, by R. K. West, West Instrument Corp. A presentation is made of new instruments and methods which extend the scope of accurate temperature control on extruders and assure control of the many variables encountered in extrusion processes.

## THERMOPLASTIC SHEET SESSION

**Moderator**, A. J. Baldwin, Nixon Nitration Works.

**Plug Assist Forming: A New Sheet Fabrication Technique**, by J. W. Mighton, The Dow Chemical Co. The plug assist technique affords easier

fabrication and widens the scope of vacuum forming. The advantages and problems are discussed and examples are used to show better uniformity of wall thicknesses.

**Large Area Stretch-Oriented Acrylic Sheet**, by A. Batzdorff, Rohm & Haas Co. The technique, machinery, and possibilities of stretching acrylic sheet from commercially available sizes to large, unspliced sheet are reviewed; suggested designs are presented for a production-type semi-automatic machine.

**Processing and Applications for Cellulose Acetate, High-Impact Styrene and Polyethylene Sheet**, by C. K. Henry, Celanese Corp. of America. Both press and vacuum forming are discussed and sound and color movies show what happens when a plastics sheet is heated and formed.

**Measuring the Effect of Plasticized Vinyl on Impact Styrene**, by R. R. Dixon, Westinghouse Electric Corp. It is shown that, by stressing polystyrene in contact with a vinyl compound at a given temperature for a given time, the quantitative effect of plasticizer migration from the vinyl can be measured after a few hours, by measuring the flexural strength of the polystyrene.

**Characteristics of Biaxially Stretch-Oriented Acrylics**, by D. A. Hurst, Rohm & Haas Co. Data are presented to show the effects of varying the temperature and the rate of stretch on properties such as crazing resistance and impact strength.

## RESEARCH SYMPOSIUM

**Moderator**, Bryce Maxwell, Princeton University.

**Flow Behavior of Plastics Under Molding Conditions**, by D. I. Marshall, Bakelite Co. Studies are reported which reveal the factors which influence mold fill-out and the force needed to form a piece.

**Plasticity as a Tool in Resin Development**, by G. P. Rowland, Firestone Plastics Co. A plate plastometer utilizing a ½-g. sample of raw resin is described and it is shown how information can be obtained on molecular weight, conversion during

(To page 228)

# Machines for Thermoplastics

**B**ECAUSE of the rapid increase in importance of vacuum forming, the sales figures for this type of equipment have been included this year for the first time in the annual MODERN PLASTICS' machinery sales tabulations.

In order to arrive at a fair figure for the number of machines in operation at the beginning of 1955, a survey of the industry was made. The consensus was that about 500 machines were in operation at that time. This figure is the approximate total of machines sold from 1950 to December 31, 1954. During the year 1955, over 300 machines were sold, increasing the sheet forming capacity not by 60% as machine totals show, but more likely by 100 to 125% because of the steadily increasing area of the heater units on many of the new machines put into operation in 1955.

During 1954, the sales of injection machines dropped 19% and it was suggested that the vacuum forming process was making serious inroads on injection. This may or may not be true, but the increase in injection machine sales during 1955 over 1954 (almost 8%), coupled with the phenomenal growth of vacuum forming, seems to point to just one fact—many vacuum formed products, skin packaging for example, have never been made before and could not be made by injection. Thus, vacuum forming is not tending to run injection out of business but instead is creating new or previously

untouched markets for thermoplastic materials.

The extrusion machine picture is even more outstanding. Sales for 1955 were up 25% over 1954. Here again the impact of vacuum forming

has made itself felt. Vacuum forming uses film and sheet; most film and sheet is extruded, hence the terrific rise in extruder sales can be attributed directly to the increase in demand from the vacuum formers.

**Table I—Machines in Use and Delivered**

	1949	1950	1951	1952	1953	1954	1955
<b>Injection Machines</b>							
Machines in the industry	4814	5683	6251	7015	8204	9181	10,233
Machines delivered in year	712	869	568	764	1189	977	1052
<b>Extrusion Machines</b>							
Machines in the industry	1987	2307	2792	3279	3828	4425	5178
Machines delivered in year	346	320	485	487	549	597	753
<b>Vacuum Forming Machines</b>							
Machines in the industry	—	—	—	—	—	500	807
Machines delivered in year	—	—	—	—	—	—	307

**Table II—Shipments of Injection Machines**

Capacity oz.	Number of machines shipped							
	Domestic				Export			
	1952	1953	1954	1955	1952	1953	1954	1955
Up to 2½	231	231	306	252	33	33	33	27
3-4-6	249	329	262	351	28	14	25	11
8-9-10	111	250	115	97	36	42	29	6
12-16	107	274	208	241	2	15	16	11
20-24-28	31	40	36	68		2		1
30-32	16	29	15	6		1	2	2
48-50	10	21	23	16		2	2	3
60 and over	9	15	12	21			1	2

**Table IV—Shipments of Vacuum Forming Machines**

Heater size* in.	Number of machines shipped 1955
Smaller than 24 by 36	66
24 by 36	97
50 by 30	89
72 by 42	30
Larger than 72 by 42	25

\*Because there is no standardization of heater dimensions, machines in the Table have been grouped in the categories which are nearest to the actual sizes reported by the manufacturers.

**Table III—Shipments of Extrusion Machines**

Screw size in.	Number of machines shipped							
	Domestic				Export			
	1952	1953	1954	1955	1952	1953	1954	1955
Up to 1½	90	101	81	106	17	22	20	21
2-3	177	207	163	268	58	37	24	21
3-4	119	136	199	207	46	20	28	12
4½ and over	101	105	154	172	16	12	18	21

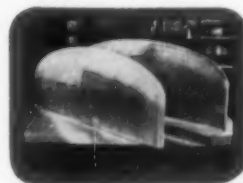


Multiple items with deep draws are economically and efficiently drape and vacuum formed from Marblette phenolic dies. Rapid mass production occurs with faithful reproduction of minute detail that registers accurately with designs preprinted on thermoplastic sheets.

Photo courtesy Majestic Creations, Inc., Woodside, L. I.



Large metal parts like this aluminum gas tank are hydroformed on dies of dimensionally stable Marblette resin # 76.



Lay-up molds of resin # 76 are utilized to produce polyester-impregnated fibrous cloth wing tips by bag molding.



Pattern duplicates for mass-production latex dipping are made from resin # 71 to slim down girdle manufacturing costs.

## Marblette Phenolic lowers costs, steps up efficiency of vacuum forming

As the ideal material for quickly and easily made dies, Marblette phenolic casting resins add a profitable plus to vacuum and drape forming.

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# PLASTICS\*

## TECHNICAL SECTION: Dr. Gordon M. Kline, Technical Editor

### The Year 1955 in Review

THE plastics industry in the United States produced more than 1½ million tons of synthetic resins and plastics in the past year. This is a 100-fold growth in the 30 years that have elapsed since the founding of this magazine in 1925. Yet the pages of 1955 are filled with prospects of still further expansion in production and markets. Especially intriguing are the new types of synthetic molecules produced by polymerization on the surfaces of solid catalysts; examples are a relatively rigid type of polyethylene and a synthetic polyisoprene that duplicates the rubber molecule made by nature.

Many scientists are exploring the effects of atomic radiation on the polymerization process and on the properties of irradiated polymers. These and other developments in materials, processes, and applications are described in this review.

#### European Progress

A survey of developments in the plastics industry in Europe provides interesting statistics which are presented in Table I (1).<sup>1</sup>

Since 1951 Germany has ranked second among all countries producing plastics. Recently, German firms in the iron, steel, and non-ferrous metals industries have become engaged in or have acquired subsidiaries concerned with the processing of plastics. Exports of plastics from Germany in 1954 increased by 70% in value, exceeding by far the general industrial average increase of 21%; exports now account for 15% of total sales of German plastics.

In Great Britain, expansions of production facilities are under way. Polyvinyl chloride production in 1955 is expected to be 60,000 tons, polystyrene capacity by the end of 1955 to be 27,000 tons, and polyethyl-

ene production to approach 35,000 tons in 1955 with increase in capacity to 56,000 tons in 1957. Over 30% of British plastics production is currently being exported.

Significant growth of production capacity and per capita consumption of plastics have also occurred in Austria, Belgium, Finland, France, Italy, the Netherlands, Norway, Spain, Sweden, and Switzerland.

#### High-Modulus Polyethylenes

Outstanding news of the year was the production of new types of high-molecular-weight polyethylenes having higher temperature resistance (up to 250° F.) and greater rigidity than previously available polyethylenes (2, 3). Two processes have been announced for the manufacture of the new polyethylenes.

The Phillips method, according to Belgian patent 530,617, employs highly hexavalent chrome oxide on a 10% aluminum-90% silica carrier. The pressure used (100 to 500 p.s.i.) is that required to liquefy the diluent, which is usually pentane or octane. The temperature of polymerization is about 155° C.

The Ziegler process, according to British patent 713,081, employs a

metal-organic complex having the general structure  $\text{Me}(\text{R})_n$ , where "Me" may be beryllium, aluminum, gallium, or indium, and "R" may be a hydrogen atom, an alkyl radical, or a monovalent aromatic radical. The temperature of polymerization is given as 60 to 250° C., and the pressure as atmospheric to 2000 atmospheres.

The higher softening points and improved mechanical properties of these polyethylenes are attributed to greater linearity of the polymer, i.e., a lesser degree of branching. Higher density and crystallinity are associated with this increased linearity, with the result that intermolecular attractive forces are greater. These in turn lead to higher tensile strength, elongation, modulus of elasticity, and melting point.

#### New Crystalline Hydrocarbon Polymers

There have been other significant applications of solid catalyst polymerization reported during the past year that are destined to affect the future position of materials in the plastics industry. One investigator (4) has applied heterogeneous catalysis to the polymerization of unsymmetrical olefins and vinyl compounds, such as propylene,  $\alpha$ -butylene, styrene, and vinyl ethers. Polymers with high melting points, high degree of crystallinity, low solubility, and special mechanical properties are obtained due to a long sequence of asymmetric carbon atoms, all having the same steric configuration. Melting points of some typical  $\alpha$ -olefinic polymers prepared by this method are: polypropylene 160 to 170° C.; poly- $\alpha$ -butylene 125 to 130° C.; polystyrene 230° C. Propylene may soon join the growing list of important raw materials for plastics.

The same principle has also been

Table I—World Production of Plastics

Country	Plastics Production	
	1950	1954
	1000 tons	1000 tons
World total	1500	2400
United States	1034	1335
West Germany	113	338
Great Britain	135	250
Japan	18	94
France	27	78
Italy	15	57
Netherlands	—	28
Sweden	14.5	27
Switzerland	—	22.5

\* Reg. U. S. Pat. Off.

<sup>1</sup> Numbers in parentheses link to references starting on p. 150.



Courtesy E. I. du Pont de Nemours & Co., Inc.

Strength and attractiveness of polyester film (in this case metallized and then embossed) combine to make decorative, non-tarnishing, and scuff-resistant book covers

used to synthesize for the first time a rubber that has the same molecular unit structure as the natural rubber hydrocarbon (5, 6). Since the latter is recognized to be a *cis*-polyisoprene, the new rubber is termed a synthetic *cis*-polyisoprene. Its second order transition temperature is the same as natural rubber ( $-68^{\circ}\text{C}$ .), but the molecular weight is somewhat lower. Truck and bus tire tests indicate that the performance of the synthetic *cis*-polyisoprene under these high temperature operating conditions is comparable to that of natural rubber and superior to that of styrene-butadiene rubber. This development may have an important effect on the future supply and demand for styrene.

### Irradiation of Plastics

Two firms are now applying radiation chemistry to produce improved properties in commercial polyethylene products. The General Electric Co. is making irradiated insulating tapes and films; the American Agile Corp. is using irradiated sheet to form chemical plant equipment and is also post-irradiating fabricated parts. Both companies are using electron generators; a 1-m.e.v. machine irradiating an object from both sides will penetrate a thickness of about 1 centimeter. The polyethylene becomes slightly cross-

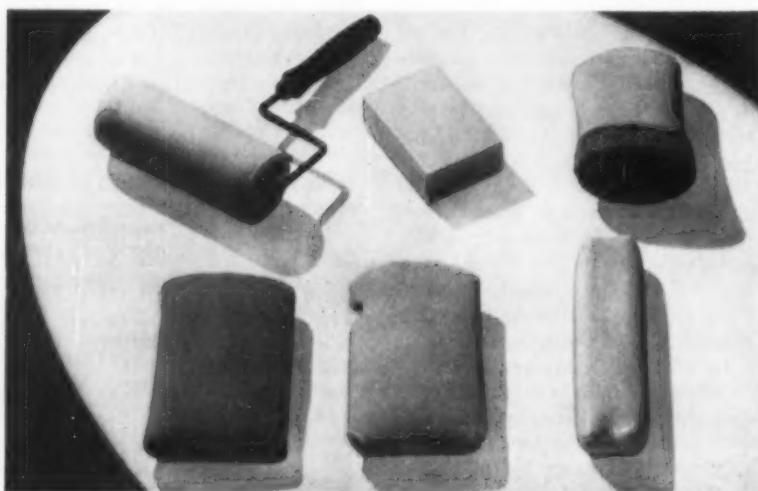
linked, just enough to make it non-melting at temperatures as high as  $350^{\circ}\text{F}$ ., and resistant to stress-cracking (7).

Another important application of irradiation in the plastics industry utilizes beta particles to control thickness of film and sheeting. These beta gage systems can include servo-mechanisms that automatically make the necessary corrections in the processing equipment to keep the product within established tolerances (8).

It is the use of irradiation for catalysis of polymerization and modification of properties of thermoplastics by cross-linking that occupies most of the research effort today. A survey of plastics manufacturers indicates that several have installed their own radiation sources and facilities, generally using cobalt-60 as a gamma-ray source (9). Numerous reports have described the results obtained in the irradiation of polyethylene (10-12), polystyrene (13), methyl methacrylate (14), and other polymers and monomers (15-22). Improvements in equipment and instruments needed for experiments with radioactive materials have resulted in simplification and economy (23-25).

### Isocyanate Plastics

Commercial production of raw materials at the rate of several hundred tons per month for the manufacture of isocyanate plastics was inaugurated in 1955 by the Mobay Chemical Co. (26, 27). Their new plant at New Martinsville, W. Va., will produce toluene-type isocyanate and adipic-type polyester which are reacted together to produce a polyurethane. Two other companies, E. I. du Pont de Nemours and Co., Inc. and National Aniline Div. of Allied Chemical and Dye Corp., are building new plants for production of the isocyanate chemicals; three other companies are producing pilot-plant quantities. Widespread applications are expected for the polyurethanes in foamed plastics, surface coatings,



Courtesy Mobay Chemical Co.

Applications in which flexible urethane foams can be used are many. Household possibilities include paint rollers, sponges, scrubbing pads, polishing pads, bath mitts, etc.

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## PLASTICS



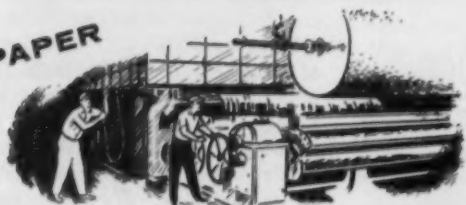
## ADHESIVES



## TEXTILES



## PAPER



## CHEMICALS



It is interesting to note that further growth is predicted for the major products made from Formaldehyde. This applies, for instance, to phenolic molding and laminating resins—urea and melamine resins for textiles, paper and plywood—and various organic chemicals.

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adhesives, fibers, synthetic rubber, and molding materials (28-31).

By far the biggest use for polyurethane now and in the immediate future is foam, both flexible and rigid (32, 33). The isocyanate chemicals can also be reacted with polyamino compounds, such as diamines, to produce polyureas, and with polycarboxylic acids to produce polyamides.

### Nylons

A variety of new commercial nylon resins have recently become available to supplement the well-known nylon 6/6, made of hexamethylene diamine and adipic acid, and nylon 6/10, made of hexamethylene diamine and sebacic acid. One of the new nylons is polycaprolactam, made by three American firms and two foreign sources. It melts at about 420° F. compared to about 500° F. for nylon 6/6 and has a relatively high molten viscosity, making it less critical to mold and extrude. It is also reported to have a more readily controlled crystalline structure and to be available in a grade resistant to the recrystallization process that leads to embrittlement in molded articles exposed to temperatures above 250° F. or to tropical environments. Two other new commercial nylons are based on alkoxy-substituted hexamethylene-adipic acid and 11-amino undecanoic acid, respectively (34, 35).

These industrial developments in nylons were accompanied by a large number of reports of new applications (36-41), investigations of physical properties (42, 43) and molding behavior (44), and studies of new derivatives and structure of

polyamides (45-48). Combinations of polyamide and epoxy resins are providing economical protective coating films that are flexible and have high impact resistance (49, 50).

### Other Materials

**Acrylics**—Acrylonitrile is an important component, along with styrene and butadiene, in a tough new thermoplastic copolymer, Cyclocac. This material is used to produce the RCA Impac radio cases which are guaranteed for five years against breaking, chipping, or cracking under normal use (51). Blends of acrylonitrile-styrene resins with butadiene-acrylonitrile rubbers are used for pipes and fittings in industrial applications where resistance to alkali and acid is required (52). The rheological behavior of polyacrylonitrile was studied by several investigators (53, 54).

The improvement in impact strength and crazing resistance imparted to polymethyl methacrylate by multiaxial stretching was also observed in stretched polymethyl alpha-chloroacrylate and a partially cross-linked methacrylate resin (55, 56). Aircraft canopies have been fabricated from stretched acrylic sheets and are now undergoing service tests. Outstanding performance of polymethyl methacrylate in factory glazing (57, 58), a patrol car top (59), and reflectors and stop-light covers for automobiles (60) was reported. New information on the properties of this plastic was published (61-65).

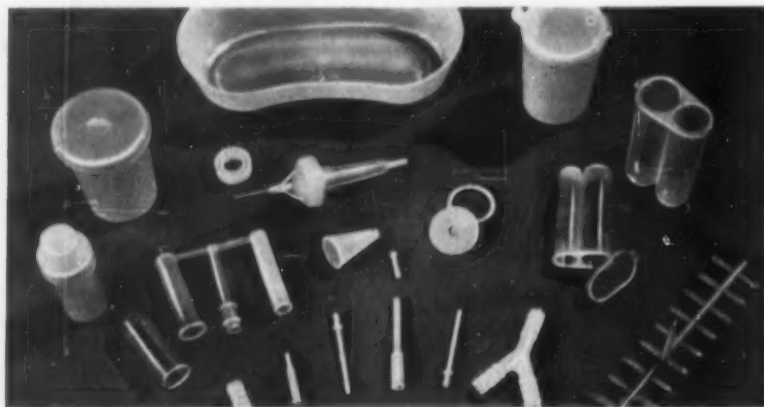
The reinforcing qualities of a series of alkyl methacrylate polymers incorporated in a butyl acrylate-acrylonitrile elastomer latex were

investigated; elastomers with a wide range of physical properties were developed (66, 67). The preparation and properties of several new polyacrylates and polymethacrylates were reported (68-71).

**Cellulose**—A modified methyl cellulose is non-ionic, surface-active, and thermogelling in aqueous solution; it is possible to extrude, mold, or cast this mixed ether of cellulose into shaped objects that are water soluble (72). Peelable coatings made of cellulose acetate butyrate, dioctyl phthalate, and a rust-inhibiting oil are finding growing use as protective wrappers (73). Other reports dealt with the preparation, properties, and analysis of cellulose acetate (74-78) and cellulose nitrate (79, 80). The commercial production of cellulose propionate was announced by Celanese Corp. of America.

**Epoxy Resins**—Many practical details on the formulation and application of these resins in coatings, adhesives, castings, moldings, and foams were given in an outstanding contribution to the technology of this material (81). Drop hammer dies cast from epoxy resins for forming sheet metal have shown cost savings as great as 50% over previously used Kirksite and lead tools (82-85). The epoxy resins are acquiring a dominant position in potting compounds for circuits and components and impregnation of electrical insulating systems (86). Applications of epoxy resins in boat hulls (87), auto body repairs (88), and pipe linings (89) were described. The growing importance of this plastic was reflected in numerous reviews of its manufacture and processing (90-94).

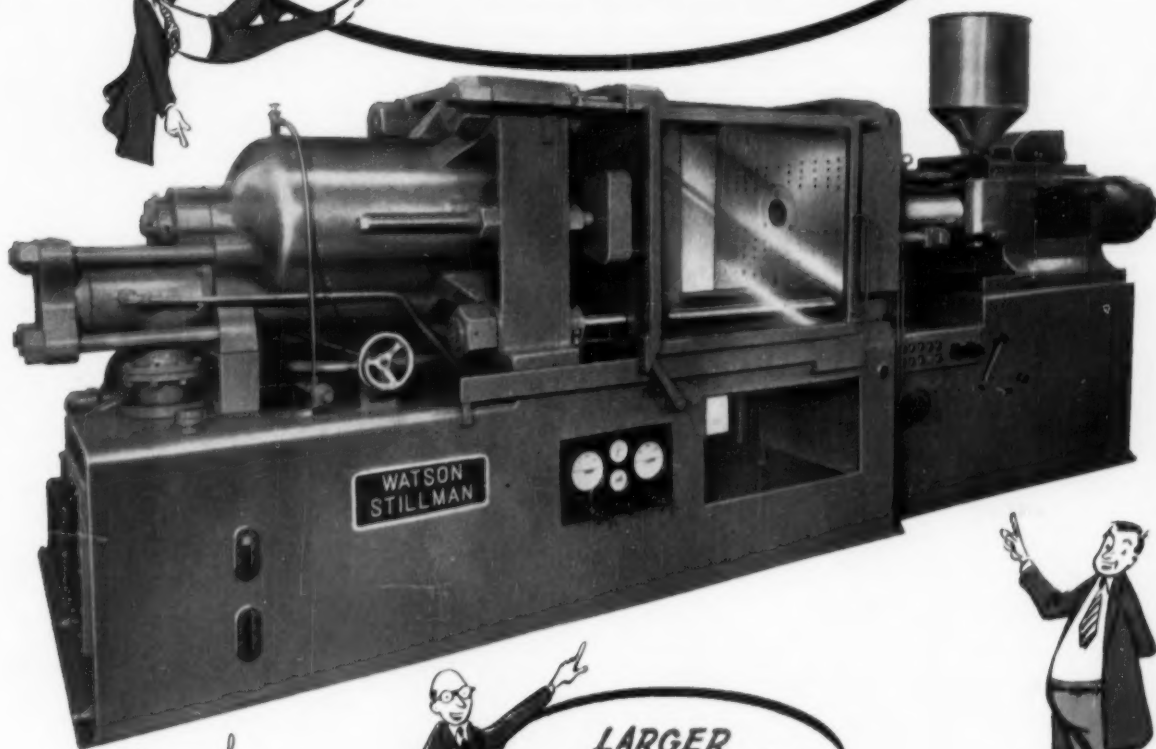
**Ethylene Polymers**—Demand and use for polyethylene is growing at a faster rate than any other plastic. Developments in the new high-modulus type were described earlier in this review. The literature is replete with reports of the uses of polyethylene in packaging (95-98), coated papers (99, 100), chemical plant equipment (101), electrical wire and cable insulation (102, 103), and as cellular material (104). A low-molecular-weight polymer, Epolene, was marketed as a synthetic wax for use in polishes, candles, coatings for food and beverage cartons, rubber compounding, bodying agent in printing inks, and impregnation of coils and condensers



Courtesy Algemene Kunstzijde Unie, N. Y.

Articles injection molded of nylon-6 for medical use; some are transparent

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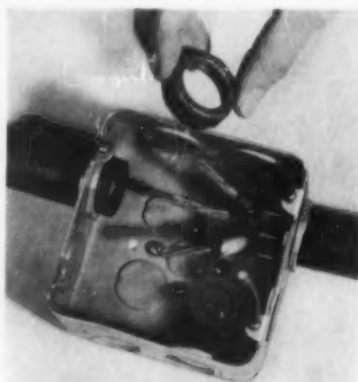
(105). Centrifugal casting of polyethylene pipe up to 36 in. in diameter was reported (106). The methods by which polyethylene can be treated to obtain ink adhesion include chemical etching, heating, flame contact, and electron bombardment (107, 108). Orientation and crystallinity in polyethylene were studied (109-111). Uses of chlorosulfonated polyethylene were reported to include coatings, acid hose, linings for chemical tanks, and white sidewalls for automobile tires (112).

**Fluorocarbons**—Many advances in the fabrication and use of polytetrafluoroethylene were reported (113-115). Filled fluorocarbon compositions can be made that are superior to unfilled Teflon in such properties as resistance to deformation under load, stiffness, thermal conductivity, compressive strength, and hardness (116). A machine has been perfected for automatically preforming a wide range of sizes and shapes with close weight control (117). Teflon fiber in the form of woven fabric has proved to be superior to other materials for packing for pump shafts, gasketing, filter cloths, roll covering, and conveyor belts (118). Teflon dry bearings have exceptionally low coefficient of friction and high wear resistance and are useful where rubbing speeds are low or where provision is made for dissipation of heat (119-121). The thermal stability of some polyfluorocarbons was investigated (122).

**Polyesters**—Ortho-hydroxybenzophenone derivatives have been found to be very effective stabilizers against the destructive action of ultra-violet light when used in translucent polyester-fibrous glass panels as decorative and structural materials for skylights, awnings, porch roofs, partitions, and the like (123). Molding compounds prepared with polyester resins (also called alkyd molding compounds) were reported to have the best all-round electrical properties of the thermosetting plastics (124). Transparent plastics made by copolymerizing triallyl cyanurate and diethylene glycol diallyl carbonate have heat distortion temperatures above 200° C. (125).

**Polyester film** (Mylar and Terylene) can be metallized or laminated and can thus be used in combinations of thin-gage film (down to 1/4 mil) with low-cost materials. It is

finding wide acceptance in the packaging field; other applications include recording tapes, drum liners, electronic capacitors, building insulation, and metallized textiles. Problems of static and sealing are being investigated (126-128). Motion picture film base (Cronar) made of the same material allows 35% more footage on a standard reel and has exceptionally good dimensional stability; continuous production began in 1955 (129). The properties of various other polyesters prepared in



Courtesy Eastman Chemical Products, Inc.  
Tough molded acetate screw-on bushings are used on conduit ends

the course of the commercial development of polyethylene terephthalate (Mylar) were described (130).

**Silicones**—A symposium devoted to these polymers covered their applications in textile treatments, protective coatings, rubbers, and molding resins. Designers were reported to have achieved a 30% savings in weight and space requirements for naval shipboard electrical equipment (131-138). Many other papers describing developments in silicone plastics (139-143) and rubbers (144-146) testified to the growing industrial significance of these polymers. Four types of silicone preparations for use as release agents in the plastics industry were described: fluids, semi-solid compounds, resins, and aqueous emulsions; general rules for selection of a release agent were presented (147).

**Styrene Polymers and Copolymers**—Technical trends in styrene plastics were analyzed in a review that covered raw materials, derivatives of styrene, polymerization, copolymerization, alloys, and molding

practices (148). Results of a comprehensive investigation of plasticizing (internal) and nonplasticizing (external) lubricants for polystyrene were reported (149). The many applications of styrene polymers reported in the 1955 literature included investment castings (150), brush filaments (151), dentures (152), insulators (153), and light fittings (154). Styrene copolymers and alloys are being used for structural housings (155, 156), sign engraving stock (157), and parts formerly made by metal stamping (158). Information was published on the weather resistance (159), electrical properties (160), thermal stability (161), crazing (162), and impact strength (163) of styrene plastics. Derivatives of styrene investigated included butylstyrene (164), sulfonated (165) and chlorinated (166) products, and graft copolymers (167).

**Vinyl Polymers and Copolymers**—Vinyl-to-metal laminates are providing materials for luggage, instrument cases, super-market checkout counter tops, television cabinets, wall coverings, containers, and the like. At midyear 15 firms had entered this new field for vinyls. Specially formulated elastomeric vinyl sheet is combined with steel, aluminum, magnesium, and copper by the use of adhesives that develop sufficient bond strength to withstand deep drawing and other forming operations (168-170). A combination of vinyl sheeting and reinforced plastics is the newest laminate undergoing trials in the business machine housing field (171). Another combination of vinyl with fabrics to produce conveyor belting has received increasing attention during the past year, under the stimulus of the trend toward automation in industry. Vinyl-impregnated and vinyl-covered belts provide a tough and easy-to-maintain conveying system resistant to oil, abrasion, and combustion. Mass-production industries, such as those engaged in packaging, food handling, automobile manufacture, mining, and electrical equipment assembly, are making use of such belting to transport materials and parts (172-175).

A review of developments in the production of breathable vinyl film and sheeting covered electrical and mechanical methods of perforation and described two breathable vinyl-

*From the Cabot Research and Development Laboratories, constant progress promises the development of new and improved plastics chemicals . . . watch for the introduction of new Cabflex® plasticizers in 1956.*



**PLASTICS CHEMICALS DIVISION**

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Courtesy New York Naval Shipyard

Small boat for the aircraft carrier *Bonnington* is made virtually unsinkable by inserting blocks of expanded polystyrene foam, sawed to size, into the open wall sections

coated fabrics marketed in 1955 (176, 177). Outstanding papers provided detailed information on calendering and spread-coating operations in the manufacture of vinyl-coated fabrics (178, 179), vacuum forming of decorative elastomeric sheeting (180), rotational molding of hollow objects from plastisols (181), and continuous heat-sealing of vinyl film to make inflatable products (182). Application reports included garments (183, 184), tapes (185), concrete coatings (186), vinyl paints (187, 188), rollers (189), photo-sensitive film (190), and the use of rigid vinyls in glazing (191, 192), mine ducting (193), and food packaging (194, 195).

Plasticizer systems for polyvinyl chloride received considerable attention (196-199); among new compounds studied as vinyl plasticizers were esters of pinic (200), itaconic (201), aconitic, and tricarballic acids (202). A series of articles dealt with stabilizers for vinyls (203). Properties of polyvinyl chloride plastics that were investigated included viscosity stability (204), flow (205), weathering (206, 207), resistance to heat and light (208), and mechanical behavior (209, 210).

Other vinyl plastics covered in the literature included those based on vinylidene chloride (211-214), vinyl formal (215), vinylpyridine (216), and vinyl stearate (217-219).

**Other Polymers**—The versatile phenolic resins approached in 1955 the 500 million-lb. annual production rate, already attained by the vinyls and styrenes. Among the applications of phenolics described in the literature were foundry molds (220), tooling (221, 222), aircraft parts (223, 224), resin-treated wood (225), and Microballoons for floating evaporation barriers and featherweight foams (226). Reports on urea plastics covered molded-in decoration for tableware (227), dimensional stability (228), and the chemistry of their formation (229). Other authors dealt with asphalt compositions (230, 231), epoxy-furane blends (232), polyesters prepared from vanillic acid of lignin origin (233), cashew nut shell resins (234), polysulfides (235), rubber-resin compositions (236, 237), polysulfones (238), aromatic polyhydrocarbons (239, 240), polyamines (241, 242), alkyds (243-245), allyl copolymers (246), ketone resins (247), and block copolymers (248). Sodium is assuming an important role in the manufacture of monomers and polymers (249). Developments in polymerization techniques, catalysts, processes, and equipment were reviewed (250, 251).

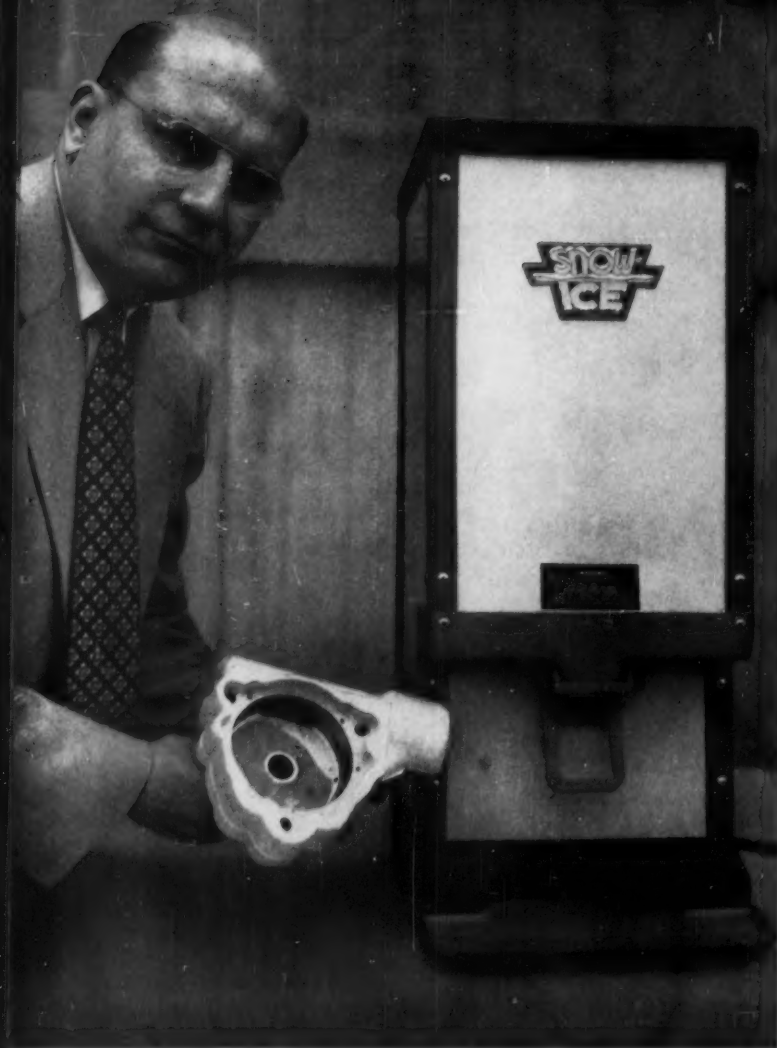
**Reinforced Plastics**—The parade of spectacular as well as functional products made of polyesters and fibrous glass continued through

1955. The biggest were geodesic structures with metal or wooden frameworks and plastic skins; one of these, 83½ ft. in diameter and 32½ ft. in height, is in use as a barn in Canada (252-255). Other entries included a new light plane (256), truck and car bodies (257, 258), tanks and pressure bottles (259-261), fuel-cell liners (262), food-handling machine housings (263), refrigerator parts (264), private swimming pools (265), billboard trim (266), pallets (267), hammer handles (268), school furniture (269), bodies for miniature cars (270), and patching kits (271).

A new type of glass reinforcement appeared in the form of fine flat glass scales, 0.0001 to 0.0002 in. thick; especially high loadings can be obtained, e.g., up to 85% with polyesters and 70% with epoxy resins (272). Another promising development in reinforcing materials was the production of fibers from metals by the Armour Research Foundation (273). Other reports on reinforcements dealt with parallel glass fibers (274, 275), glass mats (276), glass-premix molding compounds (277-279), and cellulose fibers (280). Many contributions were made to our knowledge of the mechanical (281-287), thermal (288, 289), and electrical (290) properties and structure (291) of reinforced plastics.

**Foamed Plastics**—Flexible foam production in 1953 exceeded 160 million lb. and is expected to reach 400 million lb. by 1960, divided among rubber, vinyl, and polyurethane types. The capital investment cost per unit volume of foamed rubber latex is about twice that of vinyl or polyurethane foam. The properties and market potentials of each of these three types of foams were compared (292). Special applications of silicone (293), styrene (294, 295), and polyurethane (296) foams were described (297, 298). Five reports dealt with the properties and applications of plastics sandwich materials (299-303).

**Plasticizers, Colorants, Fillers**—Plasticizer production in 1954 was approximately 300 million lb., a small increase over that of 1953. Chief interest centered in plasticization of polyvinyl chloride (196-199). New plasticizers investigated included alkyl amates (304) and esters of pinic (200, 305), itaconic (201), and aconitic and tricarballic acids



Gear case, bowl and hopper castings are insulated with a  $\frac{1}{2}$ " thick shell of Dylite expandable polystyrene. Pre-expanded Dylite beads are placed in a mold around the castings. 270° F. steam further expands the beads, binding them tightly to the castings. The completely insulated parts are then assembled in the machine.



## "It was not possible to produce this machine before Dylite\* Expandable Polystyrene"

says William L. Parsons, Asst. to the President, Brockman Tool & Manufacturing Co., Bala Cynwyd, Pennsylvania

"They laughed when we wanted to make a counter type snow ice machine," said Mr. Parsons. "The almost impossible problem lay in finding an insulation that would prevent condensation from forming on the machine. We needed a material to meet these critical requirements: high insulating value, light weight, low thermal conductivity, high strength, easy moldability and production handling.

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The unusual physical properties of Dylite expandable polystyrene make it perfect for all types of insulation applications. This new material is also being used for packaging, displays, toys and buoyant marine equipment. For more information send for our free illustrated booklet today, Koppers Company, Inc., Chemical Division, Dept. MP-105, Pittsburgh 19, Pennsylvania.

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(202). Two reports dealt with stabilizers for vinyl resins (203, 306). Practical problems in the measurement and specification of small color differences (307) and in the dispersion of pigments in plastics (308) were reviewed. Articles on fillers and reinforcements covered the effects of particle size (236, 309) and new types of glass (272) and metal (273) reinforcements.

## Processing

**Molds and Molding**—Inexpensive cast molds for short runs by compression or injection molding can be made of a mixture of 80% powdered metal (aluminum and steel) and 20% quick-curing thermosetting resin (310). Cast plastics tooling for molding plastics parts cost 30 to 70% less than their metal counterparts. The chief plastics used in cast tooling are epoxies, polyesters, and phenolics (311-313). Flexible vinyl molds are useful for casting epoxy parts (314). Steels (315, 316) and low-melting alloys (317) for the production of metal molds were described. Many important developments in mold design and manufacture were reported (318-322).

Precise measurement and control of temperature and pressure in the molding cycle received primary emphasis in the numerous contributions relating to injection molding (323-330). Other authors reported innovations in extrusion (331-334), compression molding (335), preforming (336), blow molding of bottles (337), dip (338), and bag molding (339).

**Fabricating and Finishing**—Production of three-dimensional shapes from a wide variety of thermoplastic sheets by vacuum or pressure forming methods has now become a major processing technique in the plastics industry. It is expected that sheet forming will consume over 200 million lb. of plastics annually by 1960 (340). There were many developments in equipment and applications in the vacuum forming field in 1955 (341-349).

Detailed consideration was given to formulation of paints for application to plastic products by spraying and silk screening and of finishes to be used in conjunction with vacuum metallizing of plastics. In addition to their decorative value, such coatings may increase the resistance of the plastics to abrasion, chemicals, moisture, and light (350-353).

Automation was emphasized in operations pertaining to resin handling (254, 355) and deflashing of molding (356). Heating (357-359), sealing (360), and dermatitic (361) problems were considered.

A symposium on statistical quality control pointed up methods of obtaining facts regarding the natural tolerance of a manufacturing process, the factors contributing to the variability, the effects of the variability on service use, and the preparation of realistic specifications for the product (362, 363). Methods of dimensional control of extruded products (364) and X-ray inspection of fabricated products (365) were described.

## Applications

Attention was focussed on plastics as a new class of engineering materials of construction for the chemical industry in a 15-paper symposium. The need for design data that can be used with assurance was emphasized. Designing plastics into new plants requires engineering data, ensured sources of supply, and specifications—all well established for metals,

scribed many successful applications of plastics in heavy and fine chemicals plants, petroleum production, and textile fiber and food processing plants, and listed some of the present shortcomings and needs (366).

Plastics linings for shipping containers and interior coatings of tanks, vats, and other processing and storage vessels provide resistance to corrosion and light weight (367). A comprehensive investigation of the use of reinforced plastics for the construction of spherical and cylindrical pressure vessels indicated that reduction of weight-to-volume ratios could be achieved while meeting the other characteristics required of pressure vessels (261). Recent developments in the use of plastics for chemical engineering equipment were reviewed (368-370).

The production of plastics pipe has increased from five million lb. in 1950 to an estimated 50 million lb. in 1955. A comparison chart showed that various types of plastics pipes compared favorably with cast iron pipe on an over-all basis. Production of plastics pipe of different types in 1954 was estimated as follows in million lb.: polyethylene, 18; cellulose acetate butyrate, 4.5; styrene-butadiene-acrylonitrile, 4.5; polyvinyl chloride, 1; miscellaneous, 2 (371). Developments in pipes, valves, and ducts were reviewed (372-377).

**Building**—Trends in the building industry that offer greater opportunities for plastics are prefabrication, more open areas, more curtain and window walls, and more mechanical and electrical service equipment. The potentials of plastics in building construction can best be realized if design is based upon both the strong points and the limitations of the materials. The most uncertain factor at present was reported to be long-time durability and resistance to weathering (378). A molded module comprising ceiling, wall, and floor in one unit with integral wiring and other services is envisaged for the "house of tomorrow" (379). A transportable geodesic shelter, designed for 200-m.p.h. wind stresses and arctic snow loads, is  $\frac{1}{10}$  of a sphere, 55 ft. in diameter and 38.5 ft. high. The structure contains 361 reinforced plastic components with a total weight of six tons (252, 253).

One of the major applications of plastics in the building market is  
(To page 149)



Courtesy B. F. Goodrich Chemical Co.  
Corrosion-resistant vinyl pipe carries vinegar in a food-processing plant

ceramics, and concrete, but in early stages of development for most plastics. The symposium was divided into three groups of papers: 1) engineering aspects and evaluation of materials; 2) equipment applications, such as components for mechanical equipment, vessels, piping, valves, and ducts; and 3) industry applications. The latter group of papers de-



**BAKELITE**

**PLASTICS**

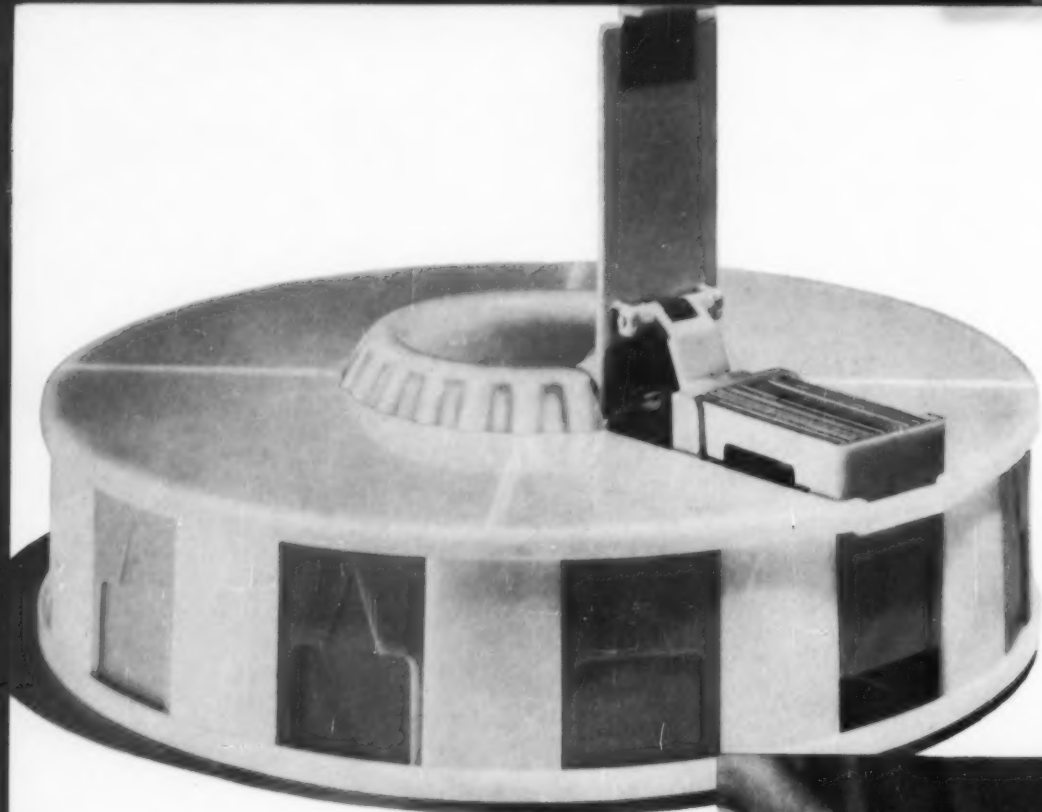
*Shortest route to the right plastic...*

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As with the four applications described on the following pages, your own product may depend for its success largely on selection of the right material.

Bakelite Company has several ways of helping you with this problem. First, by offering a broad choice of materials . . . plastics and resins that have widest application. Second, through strategic location of plants and warehouses for prompt delivery and service. Third, through the guidance of technical representatives backed by extensive research and development facilities. All this is available through one convenient source: Bakelite Company.



"Lazy Shutterbug" slide  
file case and viewer made  
by **J. & M. Zadiix  
Products Co.**,  
Brooklyn 15, N. Y.

**THIS REVOLVING FILE CASE** for 35 mm. color slides and its companion viewer (previous page) will take a lot of handling. To select slides from the case, the colored strip is dialed to the proper square. When the strip is lifted, a magazine of slides rises.

To stand up under constant operation and usage, the case and viewer are molded of **BAKELITE Brand High-Impact Styrene TMD-5151**. The smooth functioning of the component pieces testifies to the molding precision and dimensional stability of this material. Working parts are intricately formed with guides, pins, and brackets. Despite the complex design, finish is smooth, details sharp. In production, TMD-5151 demonstrates inherently high plasticity, providing the fastest set-up speed available in a high-impact styrene.

**ONE SPOONFUL AT A TILT** is automatically measured out by this dripless dispenser. No waste of contents, no extra hand motions. In addition, it's reusable on bottles with the same neck size.

Made from **BAKELITE Brand Vinyl Plastics**, the dispenser is practical for use with cosmetics, soap, detergents, antiseptics, medicines, and flavoring syrups. The smooth surface resists wear and abrasion . . . keeps its attractive appearance. Molded parts are **VG-3620 Ivory**. The gasket is cut from an extruded strip of **VG-1914 clear**. When not in use, the dispenser is capped by an airtight closure also molded of **BAKELITE Vinyl Plastic**.

"Measure Master" liquid  
dispenser molded by **Calmar Co.**,  
Los Angeles 1, Calif.  
for **Isle of View Co.**,  
Los Angeles 43, Calif.



**THESE CAPS MOLDED OF BAKELITE** Brand Polyethylene protect grease fittings. Tough and resilient, they guard against burrs and scratches, and fit tightly enough to keep dirt, grit, and water out of shims and bearings.

The caps have withstood laboratory and field tests on combat vehicles, gun mounts, amphibious tractors . . . over a temperature range from minus 40 to plus 180 deg. F., on dirt roads, through water. Greases, lubricating oils, paints, transmission fluids have so little effect that the caps can be reused indefinitely. In addition to providing durability, BAKELITE Polyethylene permitted the use of colors and kept the precise dimensions needed for a firm fit.



"Pro-Caps" for high-pressure grease fittings manufactured by **YBF Corp.**, Washington, D. C.



**A BUILT-IN "CIRCUIT BREAKER"** prevents an explosion if this flashlight's bulb is accidentally broken in the presence of flammable gases. The reflector unit has a spring-loaded retainer ring held in tension by a wire guard pressing on the bulb. If the glass bulb breaks, the electrical circuit will be instantly opened before the filament can ignite inflammable or explosive mixtures of gas in the surrounding atmosphere.

Both reflector unit and retainer ring demonstrate the strength and dimensional stability of BAKELITE Phenolic Plastic BMG 5000 Black. The parts are intricate, yet smooth-working, permitting positive, unhampered action. In production, the reflector unit with its mounts and guides, exterior threads, and slots for the wire guard are all formed in one operation in a 9-cavity compression mold. The retainer ring that holds the wire guard is produced in a 12-cavity high-speed plunger mold.

Reflector assembly parts produced by **Auburn Button Works, Inc.**, Auburn, N. Y., for "Eveready" Safety Type Flashlight made by National Carbon Co. A Division of Union Carbide and Carbon Corporation, N. Y. 17, N. Y.

*One  
plastics  
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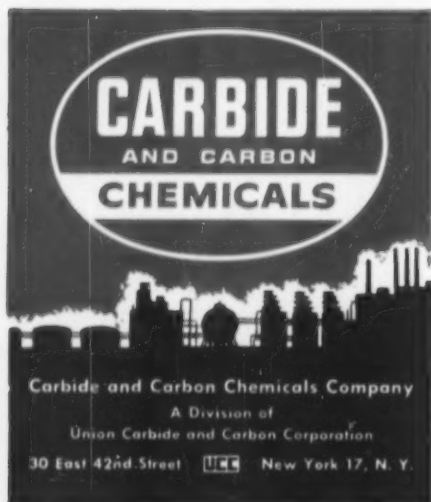


*no wrong  
numbers here . . .*

## **FLEXOL** PLASTICIZERS **DOP, 426, 810, 10-10, and CC-55**

Trade-Mark

Each one has its place in plastics, and each one rates a listing on your books. These phthalates offer excellent heat and light stability, good resistance to water extraction, and excellent electrical properties. In addition, these five FLEXOL Plasticizers allow you to select the phthalate with the proper volatility, solvent power, and dispersing action for your use. Check these phthalates before you consider any other plasticizer for your vinyl plastics or nitrocellulose lacquers.



**FLEXOL Plasticizer DOP** (di(2-ethylhexyl) phthalate)—the "standard" plasticizer for vinyls for more than ten years.

**FLEXOL Plasticizer 426** (a mixed alcohol phthalate) saves you money and offers quality, too.

**FLEXOL Plasticizer 810** (a higher alcohol phthalate) is outstanding for its low volatility and the improved low-temperature properties it imparts to vinyls. Plastics made with 810 have excellent viscosity stability.

**FLEXOL Plasticizer 10-10** (didecyl phthalate) is the least volatile of phthalate plasticizers—it has good electrical properties and is a good dispersant, too.

**FLEXOL Plasticizer CC-55** (di(2-ethylhexyl) hexahydrophthalate) is an excellent dispersant for vinyl plastisols with stable, low viscosities.

To be sure you have the right phthalate every time, call or write the nearest CARBIDE office. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Toronto.

The term "Flexol" is a registered trade-mark of Union Carbide and Carbon Corporation



Courtesy Rohm & Haas Co.

**Danger of explosions in operating room is greatly reduced by installing conductive vinyl tile flooring, shown here being tested for electrical resistance.**

wall coverings; one manufacturer estimates the 1954 consumption at the \$10 million mark with a \$50 million market by 1960 (380). Several reviews of the uses of plastics in building were published (381-383).

**Other Applications**—The automotive (384-386), aircraft (387, 388), and marine industries (389) continue to explore the potentialities of the reinforced plastics in the construction of various structural members. The 47,100,000 lb. of plastics used in the manufacture of the 5,500,000 passenger automobiles made in 1954 were distributed as follows: polyvinyl butyral, 14,000,000 lb.; polyvinyl chloride, 15,000,000 lb.; polymethyl methacrylate, 5,500,000 lb.; phenolic molding compounds, 5,000,000 lb.; cellulose acetate butyrate, 5,000,000 lb.; nylon, 2,600,000 pounds. In addition, 7,200,000 lb. of cellulose nitrate and 16,500,000 lb. of phthalic anhydride were used in lacquer and alkyd resin protective coatings (390).

Millions of parts and thousands of miles of wire and cable, made with more than a dozen different types of plastics are meeting the rigid modern requirements of missiles, television, electronic controls, coaxial cables, and printed circuitry (391-397). The increasing scope of plastics in the packaging field is evident in the plastic carboy and plastic drum; these combine chemical resistance, flexibility, toughness, and lower tare weight than comparable

glass or steel vessels (398-402). The versatility of plastics is again evident in the gamut covered by special applications, including soil stabilization (403), printing plates (404), traffic signs (405), reinforced abrasives (406), personnel safety equipment (407), zippers (408), fountain pens (409), furniture (410), vacuum cleaners (411), street lighting fixtures (412), ion exchange (413), and dimensional stabilization of fibers and fabrics (414, 415).

**Adhesives**—Reports on wettability measurements, surface free energies, and transient currents of a few milliseconds duration occurring during rupture of bonded metal specimens highlighted a symposium on adhesion (416). Ultrasonic equipment permits detection of small unbonded areas, thus providing a useful inspection procedure for quality control in production of bonded materials (417). Phenolic adhesives resistant to 600° F. are available for skin-to-core bonding of sandwich constructions with aluminum or reinforced plastic facings (418). Other authors presented descriptions of special techniques applicable to adhesive bonding (419-422) or reviews of commercial adhesives and criteria for selection of materials for specific applications (423, 424).

**Coatings**—Hot-spray formulations of vinyl resin coatings now permit application of film thickness of 2 mils or more per coat; vinyl resin mastics made with short fiber asbestos

and mica also provide material suitable for heavy intermediate coats in chemical plant maintenance (425). A thorough analysis was presented of the weathering factors—light, oxygen, and water vapor—that contribute to the degradation of automobile lacquers (426). Various methods for testing and analyzing surface coatings (427-429) and for selecting and processing finishes (430-432) were described. Reports of developments in coating materials related to polyurethanes (29), polyamides (49, 50), cellulose acetate butyrate (73), epoxies (81), polyethylene (99, 105), chlorosulfonated polyethylene (112), silicones (134), vinyls (186-188), and alkyds (243-245). Plastics engineers and designers are making wide use of coatings on plastics to achieve intricate decorative effects (350-353).

### Properties, Standards

There were many outstanding contributions to our knowledge and understanding of the strength properties of plastics. Criteria for the selection of the optimum material for structural uses were discussed; it was demonstrated that the simple ratio of strength to density is not sufficient for predicting minimum weight of a structure (433). A study of the construction of transparent enclosures for high-speed aircraft emphasized three properties: 1) thermal degradation resistance, 2) dimensional stability, and 3) useful strength (434). Tensile and impact properties of 56 materials were determined at 77, 10, -40, and -65° F. (435). The engineering aspects of utilization of plastics in chemical plants were covered in a series of articles; data pertaining to chemical resistivity, stress to rupture, creep strength, and fatigue strength are needed for the entire range of allowable working stresses (436-440).

Reports appeared relating to torsional properties (441), hardness (442, 443), frictional behavior (444, 445), abrasion resistance (446), compression (447), creep (448-450), low-temperature flexibility (451, 452), fatigue (453), and methods for measuring the tensile and tear properties of plastics films (454). Developments in testing equipment were announced (455-457).

Special problems in the measurement of electrical properties of plastics were considered by several auth-



Courtesy The General Tire & Rubber Co.  
Reinforced plastics traffic sign panels are tested for reflectability to determine the efficiency of the sign surfaces. In test set-up, board at left simulates road surface

ors (458-462). Significant progress was reported in the development of international standards for electrical insulation, motors, and components (463). Methods and equipment were described for the determination of viscosity (464-467), thermal conductivity (468), thermal diffusion in solution (469), yield point (470), and melting points of polymers (471).

Analytical procedures were published for estimation of styrene (472), glycols (473), melamine (474), and esters of various types in polyesters (475-478). Other authors reported research on dye-binding to polymers (479), cure of polyesters (480), combustion of chlorinated plastics (481), salt-spray testing (482), volume shrinkage of resinous mortars (483), oxidation of elastomers (484), permeability of plastics to various gases (485-488), and insect penetration of plastic films (489).

The molecular weight of a polystyrene fraction was determined in numerous laboratories in many countries by viscosimetry, osmometry, light scattering, and sedimentation; the viscosity and sedimentation methods gave satisfactory agreement, but the other two techniques require further refinement (490). The isopiestic method, in which vapor pressures of polymer solutions are measured, was shown to be useful in the low-molecular weight

range of 1000 to 30,000 (491). Epoxy resins were found to be especially suitable for making replicas of various optical elements with high quality surfaces (492). Ultrasonics (493) and dilatometry (494) were used in studies of relationships between molecular structure and properties.

Committee D-14 on Adhesives (495) of the American Society for Testing Materials adopted two new methods, namely, tests for susceptibility of dry adhesive films to attack by roaches (D 1382-55T) and by laboratory rats (D 1383-55T). Methods of test for consistency of adhesives (D 1084-55T) and for resistance of adhesives for wood to cyclic laboratory aging conditions (D 1183-55T) were revised and additional terms were added to the standard definitions of terms relating to adhesives (D 907-55T). Committee D-20 on Plastics adopted revisions of six specifications, four methods of test, and nomenclature and definitions of terms relating to plastics (496).

Technical Committee 61 on Plastics of the International Standardization Organization (ISO/TC 61) met in Paris in July and prepared ten draft proposals for comment by the 30 member countries. These dealt with equivalent terms and test methods for flexural properties, melt-flow index of polyethylene, bulk

factor of molding compounds, free ammonia in phenolic moldings, styrene in polystyrene, viscosity of polyvinyl chloride solutions, resistance of plastics to chemicals, and volatility and migration of plasticizers. In addition nine Draft ISO Recommendations prepared by ISO/TC 61 are being considered by the ISO member countries for advancement to the status of ISO Recommendations. The committee voted to revise its scope to include specifications as well as nomenclature and test methods (497, 498).

Two new Commercial Standards have been recently proposed by the Society of the Plastics Industry and published by the U. S. Dept. of Commerce, namely, CS 201-55 for rigid polyvinyl chloride sheets and CS 197-54 for dimensions and tolerances for flexible standard-wall polyethylene pipe. The various Divisions of the Society of the Plastics Industry are preparing other proposed commercial standards, e.g., for garden hose, thermoplastic pipe, extruded monofilaments, polyethylene film, and products made of reinforced plastics such as pipes and corrugated sheeting.

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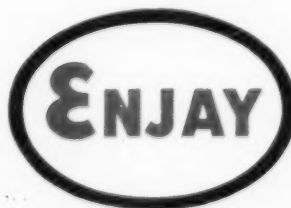
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Cut-away view of motor armature potted in epoxy resin shows windings and other parts held firmly in position

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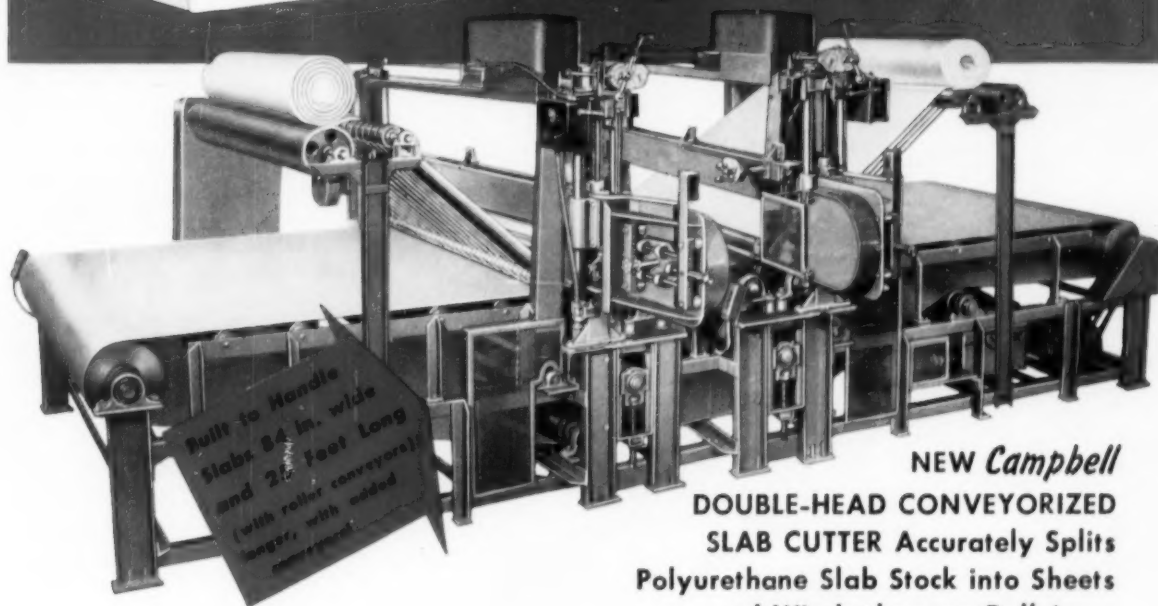
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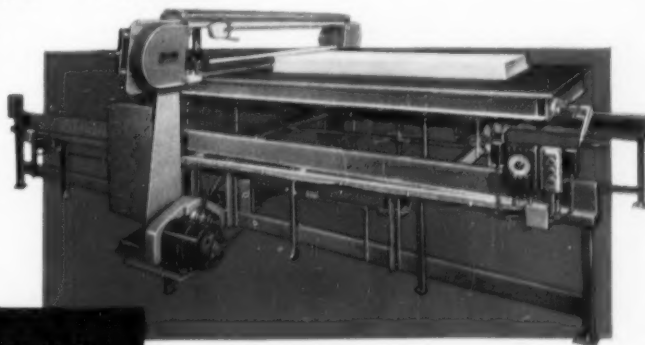
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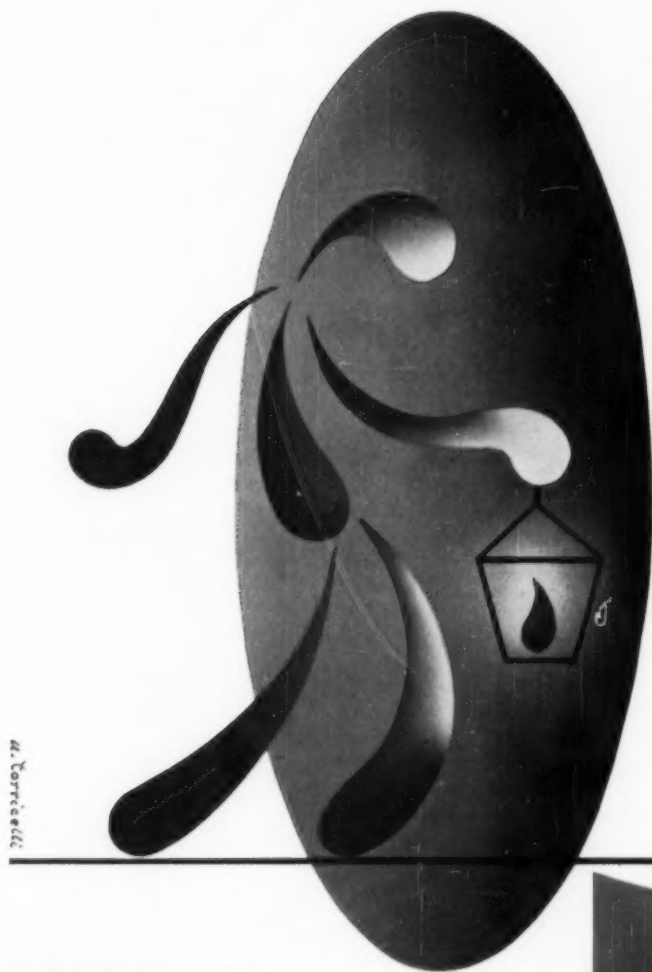
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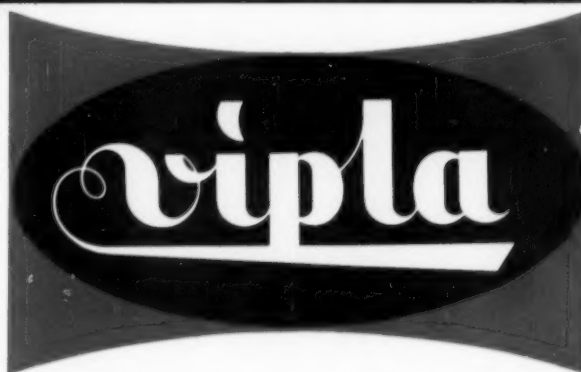
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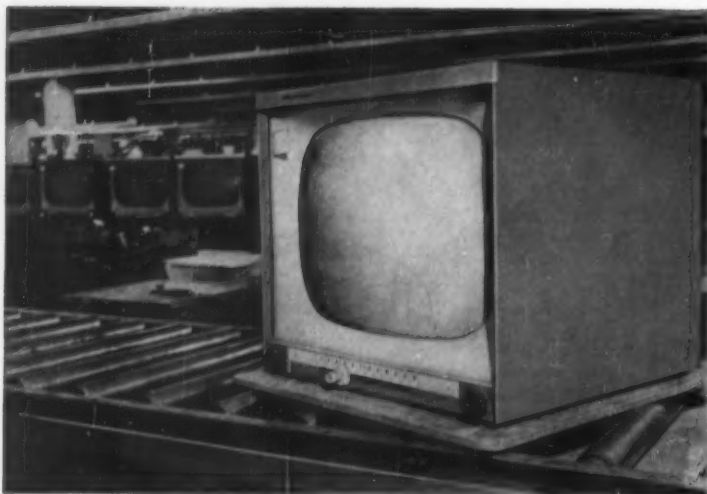
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Television set with vinyl-metal cabinet rolls off production line. Unlike receivers housed in wooden cabinets, no touching up of "bruises" is necessary

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## Materials

**NEW HIGH-STRENGTH NYLON.** M. W. Riley. *Materials & Methods* 41, 108-09 (May 1955). A new high-strength nylon has a high degree of moldability which allows commercial extrusion of transparent or translucent film and the molding of larger parts with thicker sections free of voids. The tendency of nylon to become too fluid in the mold is minimized by the relatively high viscosity of the new type material. Complicated shapes can be formed on conventional molding equipment. Properties of the resulting moldings include superior impact resistance, abrasion resistance, toughness, corrosion and solvent resistance, and self-lubricating characteristics against metals and other plastics. The new nylon is suitable for use in a diversity of applications in the aircraft, automotive, textile, electrical, and consumer goods industries, including nylon-jacketed wire, gears and cams, bushings, bearings, bobbins, spools, coil forms, switch components, instrument housings, and numerous small part applications.

**SILICONES.** J. T. Goodwin, Jr. *Chem. Eng. Prog.* 51, 31, 36A, 36B (May 1955). The silicones are pictured as a coming synthetic chemical giant in a review of the production, properties, and applications of these materials. Gradual reduction in the price of silicones is leading to increasingly diversified fields of application, including protective coatings, gasketing, antifoaming materials, release agents, water repellents, and lubricants. The properties of the silicones are discussed in relation to the particular applications to which they lend themselves.

**PLASTICIZERS FOR POLYVINYL CHLORIDE RESINS. ITACONIC ACID DERIVATIVES.** C. J. Knuth and P. F. Bruins. *Ind. Eng. Chem.* 47, 1572-78 (Aug. 1955). A number of the itaconic diesters were prepared and evaluated

in a 95% vinyl chloride-5% vinyl acetate copolymer with respect to mechanical properties imparted. The tetrahydrofurfuryl and octyl esters were the most efficient of those studied, comparing favorably with dioctyl phthalate. The reaction of itaconic esters with 1 or 2 moles of primary amine produced esters and amides of 1-alkyl- or aryl-4-carboxy-2-pyrrolidones. The esters are very efficient plasticizers for vinyl chloride copolymer resin. The butyl ester of 1-octyl-4-carboxy-2-pyrrolidone proved to be appreciably more efficient than dioctyl phthalate. Polymeric liquid plasticizers of promise were prepared by the addition polymerization of dibutyl itaconate. Suitable catalysts include peroxides and air; polymerization temperatures as high as 130 to 150° C. were necessary. Vinyl chloride copolymer compositions containing these polymeric plasticizers possess light color, fair mechanical properties and low-temperature flexibility, enhanced heat stability, and rather poor resistance to oil extraction. Attempts to apply the technique to other esters of itaconic acid were largely unsuccessful.

**LONG-CHAIN VINYL ESTERS AND ETHERS. PREPARATION FROM COMMERCIAL RAW MATERIALS.** L. E. Craig, R. F. Kleinschmidt, E. S. Miller, J. M. Wilkinson, R. W. Davis, C. F. Montross, and W. S. Port. *Ind. Eng. Chem.* 47, 1702-06 (Sept. 1955). Long-chain vinyl esters and ethers can be synthesized from acetylene and long-chain acids and alcohols. The preparation of vinyl stearate, vinyl oleate, vinyl oleyl ether, and vinyl octadecyl ether is described.

**LONG-CHAIN VINYL ESTERS AND ETHERS. COST ESTIMATE ON TECHNICAL GRADE VINYL STEARATE.** C. S. Redfield, W. S. Port, and D. Swern. *Ind. Eng. Chem.* 47, 1707-10 (Sept. 1955). The large-scale laboratory preparation, in high yield, of vinyl stearate, vinyl oleate, vinyl octadecyl ether,

and vinyl oleyl ether from acetylene and the appropriate commercial grade of long-chain acid or alcohol are described. The synthesis of these monomers of purity sufficiently high to ensure polymerizability seems commercially feasible. The monomers have potential commercial interest because their basic raw materials (acetylene and tallow) are inexpensive and readily available. In the copolymers prepared, the long chain is chemically bound in the polymer molecule, and the resulting intramolecularly modified polymers should retain their original properties indefinitely compared with changes, due to exudation, evaporation, and leaching, encountered in plasticized polymer compositions. Cost estimates based on preliminary laboratory data indicate that a plant producing 5,000,000 lb. of vinyl stearate per year should realize a profit, after taxes, from a selling price of about 43¢/lb.; at an annual production rate of 10,000,000 lb., the selling price could be as low as 31 to 34¢/pound. A return of 12% on the investment, after taxes, is assumed.

## Molding and Fabricating

**CONNECTING PLASTIC PARTS BY EXTRUSION.** F. Schaupp. *Kunststoffe* 45, 357 (Aug. 1955). It is sometimes not feasible to bond or weld two molded parts together as for instance when the bottom of a polyamide bottle must be connected with the body of the bottle. In this case the two parts are attached to each other and inserted in an extruder and the extruded material which may have a higher melting point than the body material melts the connecting parts and a perfect bond is obtained without solvents.

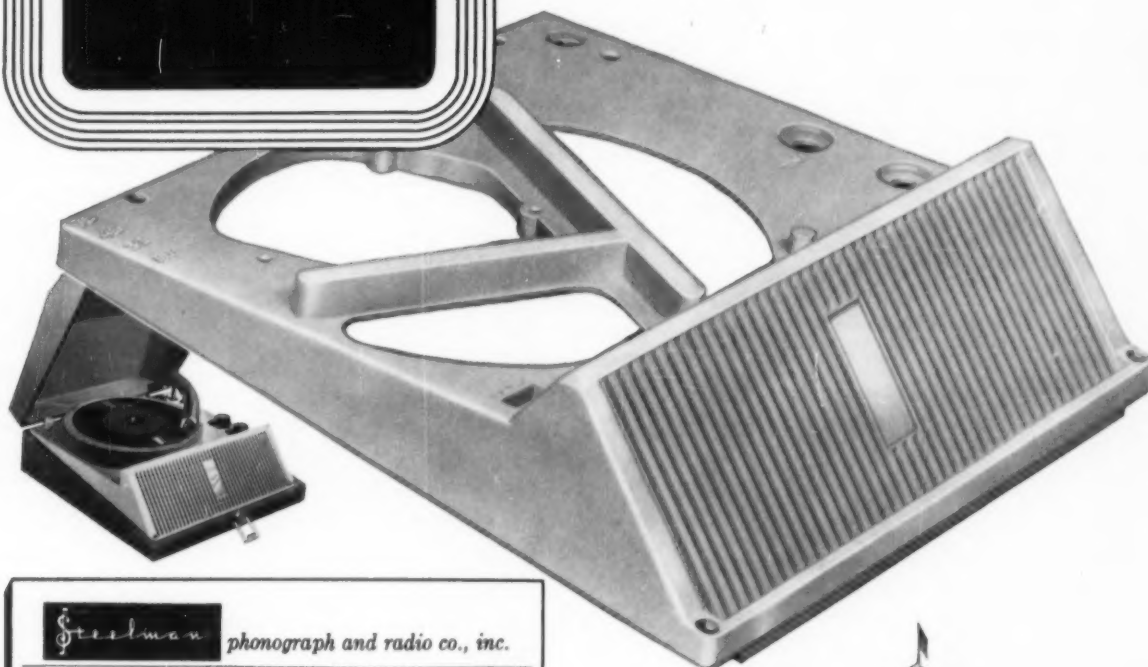
## Applications

**PLASTICS.** R. B. Seymour. *Ind. Eng. Chem.* 47, 2011-19 (Sept. 1955). Developments during the past year in the use of plastics in chemical processing equipment are reviewed. 426 references.

**APPLICATIONS FOR PLASTICS IN THE MANUFACTURE OF STORAGE BATTERIES.** *Brit. Plastics* 28, 160-63, 197 (May 1955). Various uses of plastics in electric storage batteries are described. These include the use of polyvinyl chloride for microporous separators, polystyrene for vent plugs, polystyrene for battery cases,

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**LONG PLAYING MOVIE FILM.** Chem. Eng. News 33, 4392 (Oct. 17, 1955). The properties of a new polyester photographic film base are reported. It has higher tear strength, folding endurance, aging resistance, and abrasion resistance than cellulose acetate.

**RIGID VINYL FOOD PACKAGE.** Modern Packaging 28, 82-83 (July 1955). A transparent food package molded from rigid polyvinyl chloride is described. This material was selected because it is said to be tougher than polystyrene and a better moisture barrier than cellulose acetate. Other plastics were not rigid enough, not transparent enough, or not cheap enough. A snap lid allows the package to be reclosed after once opened.

### Coatings

**PLASTIC SKIN FOR PARTS.** Modern Packaging 28, 100-101, 208, 209 (June 1955). The use of a sprayed vinyl resin plastisol as a strip coating for stainless steel and chrome trim for automobiles is discussed. A continuous conveyor system is used to carry parts through the sprayer and an infra-red oven to cure the coating.

**VINYL COATINGS' BIGGEST DRAWBACK LICKED.** K. Tator. Chem. Eng. 62, 228, 230 (May 1955). The difficulty of applying heavy coats, until recently the greatest drawback in the use of vinyl resin coatings for chemical plant maintenance and other heavy duty applications, has been solved by the development of hot-spray formulations, by the production of vinyl resin "mastics," and by the use of more active solvents which permit a higher solids content. Easily applied coatings of 2 mils or more per coat are now possible. In the hot-spray method, the increased fluidity of the warmed solution at the spray-gun and the greater volatilization of solvents during passage through the air to the surface being coated results in a deposited film of higher viscosity and higher solids than is obtainable with conventional spraying. The vinyl resin "mastics" are produced by loading the coating solution with short fiber asbestos and mica until a heavy pasty fluid

is obtained; in this type of composition, the high filler loading renders the film more permeable to moisture, so that vinyl resin mastics must be sealed by over-coating with a conventional unfilled vinyl resin to achieve top performance. A three-coat system comprising a primer, an intermediate coat of heavy vinyl resin mastic, and a conventional vinyl resin seal coat will dry to thicknesses of the order of 8 to 12 mils.

### Properties

**DIMENSIONAL VARIATIONS IN UREA-FORMALDEHYDE MOLDINGS.** M. Fuzzard. Brit. Plastics 28, 192-93 (May 1955). Results are reported of tests to study the effects of heat and humidity on the dimensions of urea-formaldehyde moldings made with four types of molding powder: conventional material, conventional material preheated, plasticized material, and plasticized material preheated. The plasticized materials showed less shrinkage than the conventional when heated at 70 or 110° C. for 14 days. Preheating had little effect and, in all cases, the shrinkage tended to level off after approximately 12 days. Under conditions of humidity, plasticized material showed a greater linear increase than conventional powders with levelling off again occurring after about 12 days.

**PERMEABILITY TO GASES OF IRRADIATED POLYETHYLENE.** I. Sobolev, J. A. Meyer, V. Stannett, and M. Szwarc. J. Polymer Sci. 17, 417-21 (July 1955). The permeabilities of irradiated polyethylene to oxygen, nitrogen, carbon dioxide and methyl bromide at 0° to 45° C. are reported. Irradiation decreases the permeability constants for all four gases.

**ADHESIVE BONDED METAL JOINTS.** R. T. Schwartz and R. E. Wittman. Product Eng. 26, 170-73 (July 1955). Measurements of room temperature shear strength on adhesive-bonded lap joints show that rates of loading from static to impact speeds have no effect on shear strength. Eight different adhesives were evaluated, ranging from relatively hard rigid types such as vinyl-phenolics and epoxides to softer less rigid types such as nitrile rubber-phenolics. Caution must be exercised in extending the conclusions to elevated or to low temperatures. It is believed that at elevated temperatures shear strength

should increase with increased rate of loading, with the opposite being true at low temperatures.

### Testing

**ANALYSIS OF LACQUERS CONTAINING NITROCELLULOSE, ALKYD RESINS, AND PHTHALATE-TYPE PLASTICIZERS.** M. H. Swann, M. L. Adams, and G. G. Esposito. Analytical Chem. 27, 1426-29 (Sept. 1955). New methods have been developed for solvent separation of cellulose nitrate, direct spectrophotometric determination of total phthalate, separation and analysis of phthalate ester plasticizers by charcoal adsorption, as well as non-volatile and phosphate ester determinations.

### Chemistry

**CHEMISTRY AND TECHNOLOGY OF UREA-FORMALDEHYDE RESINS. II. UREA-FORMALDEHYDE CONDENSATION IN ALCOHOLIC MEDIA.** H. Fahrenhorst. Kunststoffe 45, 219-24 (June 1955). Alcohol-soluble urea-formaldehyde resins are an important intermediate in the manufacture of lacquers and are used in combination with alkyd resins in baked finishes. A number of known and up to now unknown factors are discussed that show the relation between conditions of preparation, especially the pH, and the properties of the finishes made with alcohol-modified urea-formaldehyde resins. A careful adjustment of the pH will produce high gloss and good surface properties while the weathering properties of the finishes are poor when the pH is below a critical point. These experimental results cannot be explained on the basis of the classical theory of the formation of urea-formaldehyde resins. A new theory is developed.

### Publishers' Addresses

*Analytical Chemistry:* American Chemical Society, 1115 Sixteenth St., N. W., Washington 6, D. C.  
*British Plastics:* Hiffe and Sons, Ltd., Dorset House, Stamford St., London S. E. 1, England.  
*Chemical and Engineering News:* American Chemical Society, 1115 Sixteenth St., N. W., Washington, D. C.  
*Chemical Engineering:* McGraw-Hill Digest Publishing Co., Inc., 330 W. 42nd St., New York 18, N. Y.  
*Chemical Engineering Progress:* American Institute of Chemical Engineers, 120 E. 41st St., New York 17, N. Y.  
*Industrial and Engineering Chemistry:* American Chemical Society, 1115 Sixteenth St., N. W., Washington 6, D. C.  
*Journal of Polymer Science:* Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.  
*Kunststoffe:* Karl Hanser Verlag, Leonhard-Eck-Strasse 7, Munich 27, Germany.  
*Materials and Methods:* Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.  
*Modern Packaging:* Modern Packaging Corp., 575 Madison Ave., New York 22, N. Y.  
*Product Engineering:* McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N. Y.

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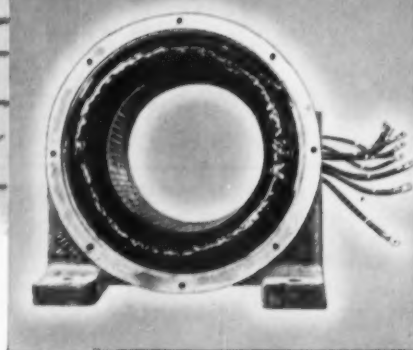
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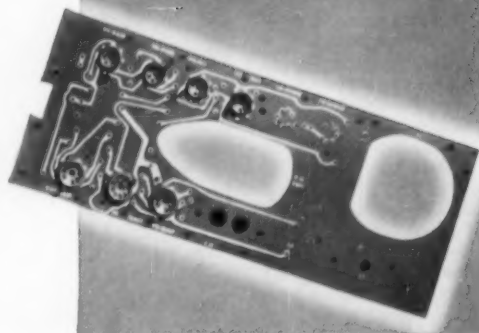
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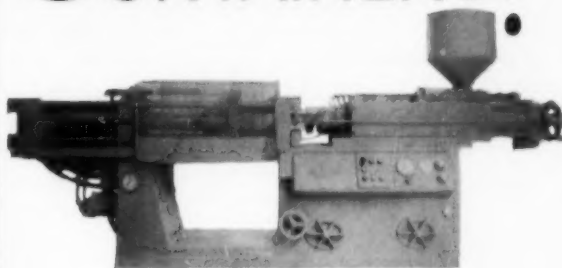
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# U. S. PLASTICS PATENTS

Copies of these patents are available from the  
U. S. Patent Office, Washington, D. C., at 25¢ each.

**POLYMERS.** A. C. Haven, Jr. (to Du Pont). U. S. 2,716,639, Aug. 30. Polymers from urea and chloroalkyl phosphonyl dichlorides.

**POLYMERIZATION.** F. J. F. van der Plas and C. P. van Dijk (to Shell). U. S. 2,716,641, Aug. 30. Polymerization process.

**POLYMER TREATMENT.** J. D. Cotman, Jr. (to Monsanto). U. S. 2,716,642-3, Aug. 30. Treating polyvinyl chloride with lithium aluminum hydride.

**POLYMERIZATION.** V. G. Simpson (to U. S. Rubber). U. S. 2,716,644, Aug. 30. Polymerization of vinyl chloride with trithioformaldehyde regulator.

**COPOLYMERS.** T. Boyd (to Monsanto). U. S. 2,716,656, Aug. 30. Organo titanium-silicon copolymer.

**TUBES.** N. Hagen. U. S. 2,716,777, Sept. 6. Shrinkable thermoplastic tubes.

**PACKAGING.** J. Feasey (to R. A. Brand). U. S. 2,717,017, Sept. 6. Sealable plastic cover.

**GASKETS.** A. C. Heatherington and U. Jelinek (to M. W. Kellogg). U. S. 2,717,024-5-6, Sept. 6. Gaskets and O-rings of polytrifluorochloroethylene.

**COATED FABRIC.** R. E. Fay, Jr. (to Du Pont). U. S. 2,717,220, Sept. 6. Fabric coated with a fused polytetrafluoroethylene and cryolite composition.

**INTERPOLYMERS.** L. L. Contois, Jr. (to Monsanto). U. S. 2,717,247, Sept. 6. Interpolymers of styrene, allyl acetate, and maleic half esters.

**POLYMERIZATION.** W. E. Vaughan and F. E. Condo (to Shell). U. S. 2,717,248, Sept. 6. Vinyl chloride polymerization.

**PRESS.** C. T. Beeson (to Plastic Products). U. S. 2,717,421, Sept. 13. Mold press.

**SANDING BLOCKS.** O. R. Rowe and W. J. Stolp (to R. H. Bouligny).

U. S. 2,717,422, Sept. 13. Cast plastic contoured sanding blocks.

**TUBES.** K. G. Francis and J. W. McIntire (to Dow). U. S. 2,717,424, Sept. 13. Vinylidene chloride polymer tubing.

**PIPE COVERING.** R. C. Jaye (to Jaye). U. S. 2,717,848, Sept. 13. Cellular plastic pipe cover.

**ACRYLONITRILE.** A. L. Miller (to Celanese). U. S. 2,717,883, Sept. 13. Acrylonitrile-N-substituted acrylamide copolymer solutions.

**SOIL CONDITIONERS.** H. L. Morrill (to Monsanto). U. S. 2,717,884, Sept. 13. Ammonium salt of isobutylene-maleic acid copolymer.

**RESINS.** S. O. Greenlee (to Devoe and Reynolds). U. S. 2,717,885, Sept. 13. Heat-hardening epoxide resins.

**POLYMERS.** R. R. Morner and R. I. Longley, Jr. (to Monsanto). U. S. 2,717,886, Sept. 13. Polymers of N-alkyl-N-vinylbenzamides.

**POLYMERS.** W. R. Saner (to Du Pont). U. S. 2,717,887, Sept. 13. Salts of vinylpyridine polymers.

**POLYMERIZATION.** M. Feller and E. Field (to Standard Oil). U. S. 2,717,888-9, Sept. 13. Ethylene polymerization.

**ORGANOSOLS.** J. F. Lontz (to Du Pont). U. S. 2,718,452, Sept. 20. Polytetrafluoroethylene organosols.

**BLENDING METHOD.** L. F. Samler (to National Plastic Products). U. S. 2,718,471, Sept. 20. Plasticizing a mass of finely divided plastic material.

**FLAME SPRAYING.** J. B. Powers (to Carbide and Carbon). U. S. 2,718,473, Sept. 20. Flame spraying polyethylene.

**RESINS.** H. A. Clark (to Dow Corning). U. S. 2,718,483, Sept. 20. Siloxane resins.

**RESIN.** L. A. Rauner (to Dow Corning). U. S. 2,718,507, Sept. 20. Reaction product of organopolysilox-

ane, polyhydric alcohol, drying oil acid, and phenol-aldehyde resin.

**RESINS.** L. A. Rauner (to Dow Corning). U. S. 2,718,508, U. S. 2,718,508, Sept. 20. Organosilicon paint resins.

**RESINS.** L. G. Lundsted and J. P. McMahon (to Wyandotte). U. S. 2,718,509, Sept. 20. Polystyrene plasticized with a polyoxypropylene glycol.

**RESINS.** P. A. Talet (to Societe Nobel Francaise). U. S. 2,718,510, Sept. 20. Urea resin syrups for paints.

**SOLUTION.** M. M. Sprung and F. O. Guenther (to General Electric). U. S. 2,718,511, Sept. 20. Solution of polychlorotrifluoroethylene.

**ELASTOMERS.** E. L. Warrick (to Dow Corning). U. S. 2,718,512, Sept. 20. Siloxane elastomers.

**PIGMENTED CHIPS.** W. A. Beardsell (to Monsanto). U. S. 2,718,513, Sept. 20. Pigmented vinyl copolymer chips.

**POLYSTYRENE.** J. Fantl (to Monsanto). U. S. 2,718,514, Sept. 20. Salts of sulfonated polystyrene.

**COPOLYMERS.** W. M. Thomas (to American Cyanamid). U. S. 2,718,515, Sept. 20. Copolymers of N-substituted acrylamides.

**RESINS.** N. M. Bortnick (to Rohm and Haas). U. S. 2,718,516, Sept. 20. Isocyanate esters of acrylic, methacrylic, and crotonic acids.

**POLYMERIZATION.** J. O. Harris (to Monsanto). U. S. 2,718,517, Sept. 20. Polymerization of 1,2-dihydro-2,2,4-trimethylquinoline.

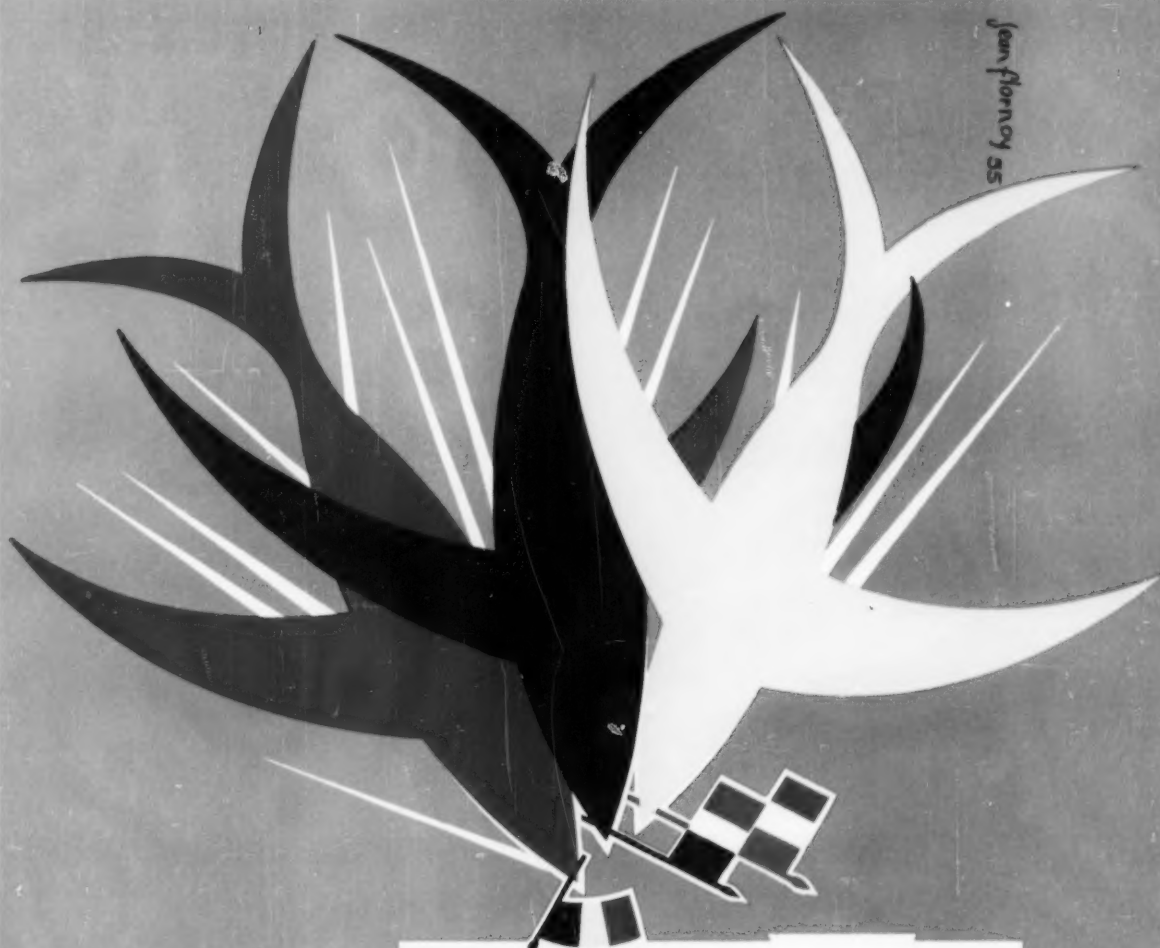
**FILM.** M. O. Longstreth and D. W. Ryan (to Dow). U. S. 2,718,658, Sept. 27. Film stretching device.

**MOLDING.** G. S. Bohannon, F. B. Williams, and R. O. Graham (to Crown Machine and Tool). U. S. 2,718,662-3, Sept. 27. Injection apparatus.

**VALVE.** R. Clade (to W-K-M). U. S. 2,718,665, Sept. 27. Plastic sealed valve.

**FILM.** K. L. Knox (to Du Pont). U. S. 2,718,666, Sept. 27. Longitudinally stretching linear polymeric material.

**SURFACT.** R. B. Seymour and R. H. Steiner (to Atlas Mineral Products). U. S. 2,718,829, Sept. 27. Portland



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**COLLAPSIBLE TUBE.** D. Deskey (to Procter and Gamble). U. S. 2,718,983, Sept. 27. Collapsible plastic tube.

**PLASTIC.** J. S. Lovell (to Carbide and Carbon). U. S. 2,719,089, Sept. 27. Flame-retardant plastic.

**COATINGS.** W. H. Voris. U. S. 2,719,093, Sept. 27. Coating an object by fusing plastic beads on the surface.

**COATING.** E. A. Goldman (to Westinghouse). U. S. 2,719,098, Sept. 27. Coating ground glass surface with a thermoset polysiloxane resin.

**FILMS.** T. F. Banigan (to Du Pont). U. S. 2,719,100, Sept. 27. Heat sealing together into laminates films of polyethylene terephthalate.

**POLYMERS.** L. A. R. Hall (to Du Pont). U. S. 2,719,131, Sept. 27. Polymers of *p*-xylene.

**POLYMERIZATION.** F. E. Schweitzer (to Du Pont). U. S. 2,719,132, Sept. 27. Polymerization of methacrylic acid diester.

**POLYMER MIXTURES.** H. W. Coover,

Jr. (to Eastman Kodak). U. S. 2,719,134, Sept. 27. Mixtures of polyacrylonitrile with polymeric phosphonic acid diamides.

**POLYMER COMPOSITIONS.** J. R. Caldwell (to Eastman Kodak). U. S. 2,719,136, Sept. 27. Polymerizing acrylonitrile in the presence of maleic anhydride copolymers.

**POLYMER COMPOSITIONS.** P. O. Tawney, R. H. Snyder, and R. W. Amidon (to U. S. Rubber). U. S. 2,719,137, Sept. 27. Composition of polyvinyl chloride and diolefin-acrylic ester copolymer.

**POLYMER COMPOSITIONS.** H. J. Hagemeier, Jr. and M. A. Perry (to Eastman Kodak). U. S. 2,719,138, Sept. 27. Polymerization of acrylonitrile in the presence of *N*-acyl acrylamide polymers.

**RESIN COMPOSITION.** J. E. Wicklatz (to Phillips Petroleum). U. S. 2,719,139, Sept. 27. Polyvinyl chloride-polysulfone resin compositions.

**COPOLYMERS.** R. J. Slocumbe and G. L. West (to Monsanto). U. S. 2,719,140, Sept. 27. Stabilized acrylonitrile copolymers.

**COPOLYMERS.** A. C. Smith, Jr. (to Eastman Kodak). U. S. 2,719,141, Sept. 27. Hydantoin esters of maleic anhydride copolymers.

**POLYMERIZATION.** C. P. van Kijk and F. J. F. van der Plas (to Shell). U. S. 2,719,142-3, Sept. 27. Polymerizing polyethylenically unsaturated compounds.

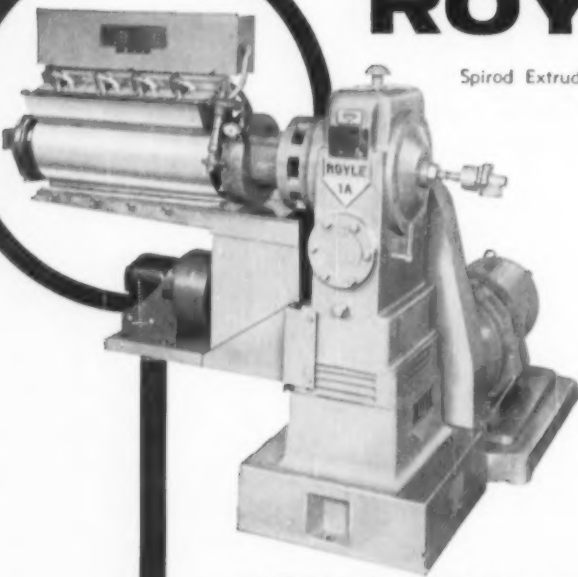
**POLYMERS.** N. H. Shearer, Jr. and H. W. Coover, Jr. (to Eastman Kodak). U. S. 2,719,144, Sept. 27. Modified polyacrylonitriles.

**PLASTIC BODIES.** T. E. H. Gray and J. Jones-Hinton (to Dunlop Rubber). U. S. 2,719,324, Oct. 4. Reducing the diameter of plastic cylinders.

**MIXING PLASTICS.** E. M. Franklin (to Hercules). U. S. 2,719,325, Oct. 4. Apparatus for mixing plastics.

**MOLDING.** R. H. Dyhehouse (to Crown Machine and Tool). U. S. 2,719,326, Oct. 4. Plastic molding machines.

**POLYAMIDES.** L. L. Stott (to Polymer). U. S. 2,719,330, Oct. 4. Polyamide rod stock.



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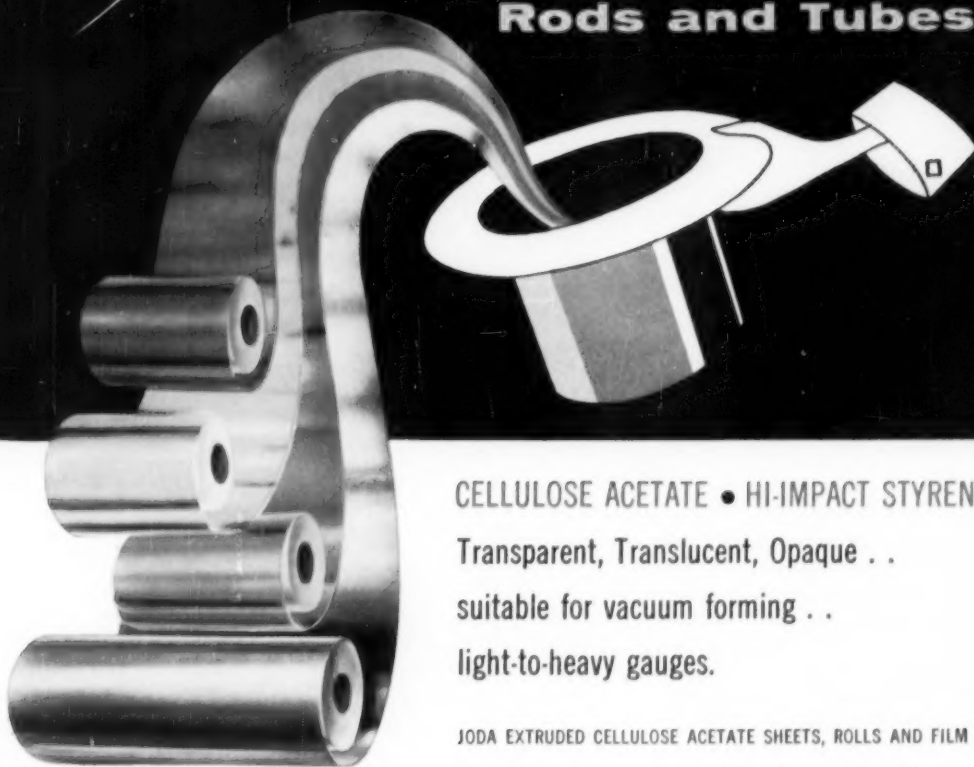
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# BOOKS AND BOOKLETS

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## **"Designing for Industry," by F. C. Ashford**

Published in 1955 by Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. 222 pages. Price: \$7.50.

Here is an effort to present, in a single volume, a complete picture of the field of industrial design.

After briefly clarifying the designer's role and discussing the general esthetics of design, the author enters upon an analysis of specific problems. Starting with just a vague idea, he develops in great detail the steps in the design and creation of an actual product. The book also covers design techniques, including drafting, rendering, model-making, and finishing. It concludes with a description of contemporary production and marketing practices.

## **"American Imports," by Don D. Humphrey**

Published in 1955 by The Twentieth Century Fund, 330 W. 42nd St., New York 36, N. Y. 546 pages. Price: \$6.00.

The history of American policy on imports, with emphasis on the tariff, an analysis of the role of imports in the American economy, an examination of many individual industries and products, and a discussion of dislocations caused by imports in certain instances, are the main subjects of consideration.

Some of the topics covered are: the troublesome import deficit, obstacles to imports, what imports might be increased, who would be hurt by the increase. The final section of the book offers recommendations for a program to help solve some of the problems that presently exist.

## **"L'ère Des Matières Plastiques," by M. Fournier**

Published in 1955 by Dunod, 92 rue Bonaparte, Paris(6<sup>e</sup>) France. 270 pages. Price: 560 F (Ca \$2.00).

Information on the nature, properties, application, and economic importance of organic materials is

presented in this concise volume. The author has reduced the discussion of theories and manufacturing methods to a minimum. However, processing of materials is treated in detail and the apparatus used is described with care.

## **"Prüfungsbuch für Kautschuk und Kunststoffe," by Karl Frank**

Published in 1955 by Berliner Union GmbH, Stuttgart, Germany. 140 pages. Price: 18 DM (ca. \$4.32).

As in other fields of industrial production, testing of raw materials in the rubber and plastics industry has assumed increasing importance, with the result that a host of test methods have been developed in industrial practice and research laboratories. The equipment that has been developed for that purpose, the various test procedures, and the operation of the test equipment are discussed in this book. Subjects covered include testing of raw rubber, intermediate products, vulcanisates, finished products, plastic film and sheeting, etc. A bibliography is given.

## **"Handbook of Barrel Finishing," by Ralph F. Enyedy**

Published in 1955 by Reinhold Publishing Corp., 450 Park Ave., New York 22, N. Y. 253 pages. Price: \$7.50.

This book, which contains more than 150 specification sheets, describes methods of finishing plastics and metal parts. Barrel finishing, from cleaning and deslugging to coloring, polishing and burnishing, is covered in step-by-step sequence. Recent developments in equipment, finishing compounds, and methods are discussed. Information on the preparation of metals for sealing to glass, deburring of screw machine parts, and multibarrel processing are also given.

**Polyamide resins**—A 16-page pamphlet, "Versamids," describes polyamide resins developed in a variety

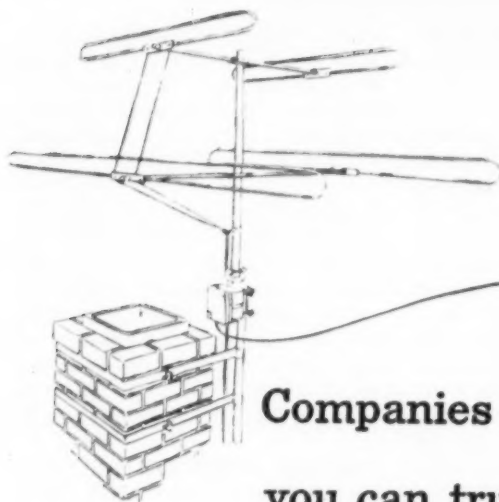
of forms for special uses. They are made by the condensation of dimerized and trimerized unsaturated fatty acids of vegetable oils with ethylene diamine. General information and specific data on each of the eight types currently marketed are given. A discussion of end uses and a table of specifications are included. *Chemical Div., General Mills, Inc., Box 191, Kankakee, Ill.*

**Molecular motion**—A 30-min., 16-mm. sound and color motion picture is the second of a series of "Adventure in Science" films produced by Monsanto Chemical Co., Plastics Div. The new film is entitled "The World that Nature Forgot" and describes how molecules are joined to form materials that are not found in nature. Colored models are used to depict the behavior of molecules in motion and molecules of ethylene, benzene, and chlorine are shown combining to form styrene and vinyl plastics. Processes by which resins are converted into sheet, powder, and crystal are shown in subsequent scenes. *Modern Talking Picture Service, 45 Rockefeller Plaza, New York 20, N. Y.*

**Lubricants**—Bulletin 105 describes two lubricants—type 165X and type LOEX. Type 165X, an open-gear lubricant, is recommended for construction machinery, elevator and escalator gear trains, mechanical presses, power shears, winches, etc. Type LOEX is suited for low-temperature applications. Physical specifications, test data, prices, and ordering information are presented. *The Alpha Molykote Corp., 65 Harvard Ave., Stamford, Conn.*

**Vulcanizing agent**—Technical Service Bulletin 123 describes a liquid aliphatic vulcanizing agent for unsaturated elastomers. Compounding information for acrylonitrile, GR-S, and natural rubbers is presented. Tables giving physical properties are included. *Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton 7, N. J.*

**Occupational diseases**—This booklet, entitled "The Prevention of Occupational Skin Diseases," describes the results of a study in which 1400 cases of occupational dermatoses in plants employing 117,000 workers were examined. The highest incidence of these industrial skin dis-



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eases occurred in the manufacture of synthetic dyes. The book discusses causes and prevention. 50¢. *Association of American Soap and Glycerine Producers, Inc.*, 295 Madison Ave., New York 17, N. Y.

**Phenolic molding compound**—Pamphlet gives physical, electrical, and chemical properties of a one-step flock-filled phenolic molding compound for parts that are in either intermittent or constant contact with water; e.g., agitators, pump housings and impellers, valves, faucets, dishwasher parts, and similar products. Molding techniques, finishing operations, and equipment are discussed. *Durez Plastics Div., Hooker Electrochemical Co., Walck Rd., North Tonawanda, N. Y.*

**Fatty acids**—Revised brochure contains specifications and characteristics of a line of fatty acids and derivatives, including stearic, oleic, and hydrogenated acids; glycerides; animal and vegetable fatty acids; special fatty acids; plasticizers; and oleic esters. *Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio.*

**Plastics plant**—A 12-page brochure describes a 227,000-sq. ft. injection molding plant and its facilities. Case histories of difficult and unusual molding jobs are discussed. *Nosco Plastics, Inc., Erie, Pa.*

**Plastic patches**—Pamphlet describes a self-curing thermosetting patching compound used for repairing holes, leaks, splits, or breaks in piping, tanks, etc. The material comes in three forms: caulking compound (resin, activator, and white-powder fibrous reinforcer); iron putty (resin, activator, and gray iron filler); and seam sealer (resin, activator, and red-powder fibrous filler). Physical as well as chemical properties and methods of application are given. *Bonded Products, Inc., 3250 N. Kilpatrick Ave., Chicago 41, Ill.*

**Polyethylene**—Eight-page brochure lists the advantages which low-molecular-weight polyethylene brings to processing of natural and synthetic elastomers. Physical, chemical, and electrical properties; tables giving summary of physical test data; and a price list of polyethylene in varying grades and weights are in-

cluded. *Semet-Solvay Petrochemical Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.*

**Textile fiber**—Booklet describes achievements of a textile firm specializing in the use of nylon and Acrylan acrylic fibers. Methods of production of Acrylan and nylon and their general textile applications and properties are outlined. Sample swatches of goods made of combinations of Acrylan, acetate, rayon, and wool yarn are included. *Monsanto Chemical Co., St. Louis 4, Mo.*

**Instrumentation**—Booklet ENT (1) is an index to manufacturer's literature covering instruments for research, teaching, and testing; instruments and controls for industrial plants; and instruments and controls for power plants. *Leeds & Northrup Co., 444 North 16th St., Philadelphia 30, Pa.*

**Welding and fabrication**—A four-page folder describes various aspects of plastic welding and fabricating. Low-pressure polyethylenes are discussed and tips on hot-gas welding of thermoplastics are presented. Photos illustrate the use of polyethylene and polyvinyl chloride in the manufacture of welded acid tanks, chemical processing equipment, and exhibition and display material. *American Agile Corp., P. O. Box 168, Bedford, Ohio.*

**Chemical industry**—This 84-page booklet gives statistics on the development and status of the West German chemical industry. Tabulations comparing the German chemical industry with other German industries and with industries of other countries are included. 3.80 DM. (ca. 91¢). *Econ-Verlag GmbH, Dusseldorf, Germany.*

**Pigment dispersions**—Technical bulletin describes a line of pigment dispersions for latex paint. Chemical and physical properties of the materials are covered. The bulletin is supplemented with color chips made with each of seven dispersions in both deep-tone and light-tint formulation. *Pigments Div., American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.*

**Fluorocarbon plastics**—Twenty-page bulletin No. IN-554 describes and

illustrates the products and facilities of a company supplying fabricated fluorocarbon parts for mechanical, electronic, and chemical-resistant purposes. *United States Gasket Co., Camden 1, N. J.*

**Glazing**—Four-page folder IC95 describes fibrous glass-reinforced plastics flat panes for glazing, with suggested construction details for metal-covered buildings and double-pitched skylights. Illustrations showing typical industrial installations are given. *Alsynite Co. of America, 4654 De Soto St., San Diego, Calif.*

**Tumbling barrels**—Bulletin XL-55 describes wet-process tumbling barrels for finishing operations on metal and plastic parts. The bulletin also contains recommendations for selecting specific chip media and suitable compounds to meet various finishing requirements. A table of specifications gives standard model numbers, tumbler sizes, and the number of compartments per barrel. *Tumb-I-Matic, Inc., 4510 Bullard Ave., New York 70, N. Y.*

**Hydraulic tables**—Revised bulletin 50 is a 28-page reference work for hydraulic engineers interested in pumping and piping problems. *Aldrich Pump Co., 25 Pine St., Allentown, Pa.*

**Styrene**—First issue of a periodical, which will deal with contour extrusion and vacuum forming, describes various mechanical properties of high-impact styrene and offers extrusion and vacuum forming technique suggestions. *Bakelite Co., Div of Union Carbide and Carbon Corp., 30 E. 42nd St., New York, N. Y.*

**Plastic fabricator**—Brochure describes facilities, services, and typical products of a plastics manufacturing plant specializing in acrylic fabrication and reinforced plastics molding. *Plastics Age Co., 649 Arroyo Ave., San Fernando, Calif.*

**Atomic energy**—A 44-page booklet, "The Atom in Our Hands," describes work being done at the atomic energy center at Oak Ridge, Tenn. Included is a description of the process used to separate billions of uranium atoms to capture the rare type of uranium 235 needed for

atomic energy operations. The booklet also tells how radioisotopes are produced. Peaceful applications of atomic energy in industry, agriculture, etc., are discussed. *Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

**Hydraulic and pneumatic equipment**—Catalog 555 describes a line of hydraulic and air-driven components, including cylinders, jacks, braces, and other units. Specifications and application data are given. *Star Jack Co., Inc., 420 Lexington Ave., New York 17, N. Y.*

**Insulating material**—Fifty-page brochure outlines facilities, equipment, services, and materials available for electrical insulation work. Charts giving chemical, electrical, and physical properties, together with engineering suggestions are offered. *Manne-Knowlton Insulation Co., Inc., 416 W. 13th St., New York 14, N. Y.*

**Distillation pilot plant**—Data sheet describes the principal parts of a 15-gal. reaction-distillation pilot plant—reactor condenser, decanter, receiver, and piping—and presents a schematic drawing illustrating these features. *Patterson-Kelley Co., Inc., 10 Lackawanna Ave., E. Stroudsburg, Pa.*

**Aerosol**—Brochure describes the development of the self-spraying package, discusses the pros and cons of the push-button container, and offers suggestions to manufacturers on how they can evaluate their products for the aerosol package. *Sprayon Products, Inc., 2065 E. 65th St., Cleveland, Ohio.*

**Pilot plants**—Described and illustrated in 4-page Bulletin 287 are pilot plants for continuous reactions. Alkylation, hydrolysis, oxidation, polymerization, copolymerization, esterification, sulfonation, and saponification are among the processes to which the units can be adapted. *Marco Co., Inc., Saginaw, Mich.*

**Primary alcohol**—Technical 16-page booklet "Arbitol" describes physical and chemical properties and applications for a primary, monohydric alcohol. Included is a discussion of the use of this alcohol in alkyd

resins, as well as general applications in adhesives, fixatives, hot-melt coatings, etc. A table is presented which lists the effects of monofunctional alkyd modifiers on characteristics of resins. *Hercules Powder Co., Inc., 900 Market St., Wilmington, Del.*

**Oils, waxes, greases**—Chemical structures, specifications, properties, applications, and general descriptions of Kel-F fluorocarbon oils, waxes, and greases for industrial use are described in a 16-page booklet. *Chemical Mfg. Div., The M. W. Kellogg Co., P. O. Box 469, Jersey City 3, N. J.*

**Vinyl resin**—Physical properties of Marvinol VR-30, a new vinyl resin developed for calendaring, are discussed in eight-page Bulletin No. 2. Data on processing the resin are also given. *Plastics Sales Dept., Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.*

**Blowing agent**—Compounding Research Report No. 36 describes properties, typical applications, and advantages of a nitrogen blowing agent for use in sponge rubber and expanded plastics. Processing information and illustrations of equipment are included. *Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.*

**Heater bands**—Pamphlet describes a line of high-voltage heater bands made of cast aluminum, ceramic, and mica. List prices, sizes, and wattage and voltage ratings are given. Suggestions for proper and efficient use of heater bands are offered. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

**Packaging**—Two booklets—"How to Pack It" and "Package Laboratory News"—describe various types of packaging designs made from corrugated boxes. *Hinde and Dauch, 407 Decatur St., Sandusky, Ohio.*

**Catalog supplement**—A 112-page supplement to Catalog 111 describes all the instruments, apparatus, glassware, laboratory furniture, and accessories added to the company stocks since 1952. *Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.*



**PLASTICS FOR CORROSION-RESISTANT APPLICATIONS** by R. B. Seymour and R. H. Steiner. Shows engineers how to select the right plastic for construction in corrosive atmospheres; the use of plastics as protective coatings, organic linings, chemical resistant mortar veneers, casting resins, plastic foams, impregnants, industrial adhesives and reinforced materials. Plastics available for a specific application are compared in tabular form for quick, easy selection of the most suitable material. 1955, \$2.50

**PLASTICS ENGINEERING HANDBOOK** of The Society of the Plastics Industry, Inc. The most complete, best arranged information ever published on the design, materials, processes, equipment, finishing, assembly, testing and standards of plastics and plastic products. Entirely rewritten, this new edition of the famous S/P Handbook is almost twice its former size. Suppliers of raw materials will find a complete set of accepted standards and specifications. Designers and engineers will find new testing methods fully described. Users of plastics will welcome the standards for testing, rating, certifying and labeling plastic commodities. 1954, \$15.00

**FIBERGLAS REINFORCED PLASTICS** by Ralph H. Baerchen. The first complete treatise ever published on reinforced plastics. Covers in full detail the resins and glass reinforcements used, molding techniques, inspection and testing, properties and design considerations. Provides all those concerned with reinforced plastics with valuable information never before available in one compact volume. 1954, \$4.50

**PLASTICS TOOLING** by M. R. Hiley. Summarizes all the information, both published and unpublished, concerning the use of plastics in jigs and fixtures, metal forming dies, plastic forming molds, the molds and prototypes. Describes tools now made of plastics, resins used, how they are made, how long they last, what they cost, etc. 1955, \$2.50

**MONOMERIC ACRYLIC ESTERS** by E. H. Riecke. Provides industrial chemists and engineers with a wealth of practical, up-to-date information on the properties, polymerization, copolymerization and chemical reactions of commercially available acrylic and methacrylate esters. Covers methods of storing and handling, explosive limits, toxicity and latest methods of determining purity. Lists physical properties of both the technical grades and purified materials. 1955, \$5.00

**STYRENE: Its Polymers, Copolymers and Derivatives** by R. H. Hoadley and R. F. Hoadley. The most complete treatment of the subject ever published. Offers a thoroughgoing account of the manufacture, polymerization, copolymerization and chemical modification of styrene and industrially important styrene derivatives. Delves deep into the chemistry of these complex substances and includes a lengthy chapter on the fabrication of polystyrene parts. Of tremendous interest and value to the plastics, rubber and other industries, and to all technical libraries. 1952, \$20.00

**EXTRUSION OF PLASTICS, RUBBER AND METALS** by H. H. Stinson, A. J. Weith and W. Rohrer. Offers for the first time a complete coverage of extrusion as an important processing operation. The first part of the book is devoted exclusively to the extrusion of plastics. Here, the versatility of the extruding machine as an industrial unit is fully described and the many applications of extruded plastics are discussed. The remainder of the book focuses attention on extrusion of metals and such materials as rubber, food products, ceramics, graphite and even ice. 1952, \$10.00

**DETERIORATION OF MATERIALS: Causes and Preventive Techniques** edited by Glenn A. Greathouse. Expert information by 24 specialists on what you can do to protect valuable materials and equipment. Describes the nature of deterioration processes and preventive measures to prolong the life of everything from raw materials to finished products. 1954, \$12.00

**THE CONDENSED CHEMICAL DICTIONARY—4th Edition**. Edited by F. M. Turner. Over 23,000 separate entries covering all recent developments, new substances, trade names, uses, applications, formulas, properties, synonym derivations, containers, shipping instructions, safety regulations. Of utmost value to everyone needing quick, accurate information on chemicals and related materials. 1950, \$12.00

**THE TECHNICAL REPORT: Its Preparation and Use in Government and Industry** edited by B. H. Weil. From the conception of its need to final destination and use, every phase of the technical report is fully covered. It will prove of great value to any engineer who must prepare or depend on reports for timely communication. 1954, \$12.00

**Hawley's TECHNICAL SPELLER** by G. G. Hawley. A quick, convenient guide to thousands of difficult technical words used in physics, electronics, engineering, chemistry, etc. Technical writers and secretaries who take technical dictation will find this book a handy time saver. 1955, \$2.95

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# NEW MACHINERY AND EQUIPMENT

## 160-oz. Injection Machine —

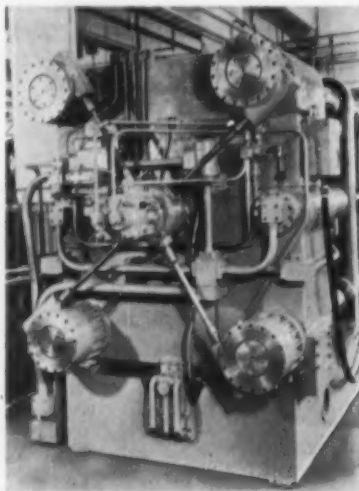
Equipped with a pre-plasticizer unit which incorporates provision for metering injection stock, the new Windsor W205 Superplas injection machine has a swept volume of 205 cu. in. of plasticized material at 12,500 p.s.i. This is equivalent to 160 oz. of cellulose acetate or 130 oz. of polystyrene. Three basic units comprise the machine: platen castings, main ram, and mold clamp; injection ram and pre-plasticizer unit; main drive motor and hydraulic units. The clamping ram and cylinder, together with the moving platen, is mounted upon bronze ways and can be moved along the machine bed as a unit to accommodate molds of different heights. Because of the great weight of the clamp unit, the adjusting nuts are rotated simultaneously by four worm drives which are actuated by a central hydraulic motor. Movement of the clamping mechanism is controlled through a manually operated valve.

The injection mechanism of the W205 machine is designed as a separate unit mounted on a base which is positioned to form a complete in-line setup. Within the base of the injection unit is the oil reservoir, most of the hydraulic valve gear,

and the electrical equipment necessary for automatic operation. The complete injection end is mounted on a sliding bed, which permits quick removal of the nozzle.

The pre-plasticizing unit has a fast reciprocating and continuously feeding plunger which forces the material through a stainless steel plasticizing channel.

It is reported that the injection



Clamp end of W205 Windsor injection machine; nuts are driven simultaneously

pressure on pre-plasticized material can be quite low because of reduced losses brought about by the pre-plasticizing unit. Because of this, injection pressure is variable from 5,000 to 12,500 p.s.i.

Material from the pre-plasticizer is fed into a transfer chamber where it is retained by a hydraulic nozzle valve and held until injection takes place. Reilling of the transfer chamber is automatic and does not require auxiliary timers, limit switches, or other equipment.

Final mold clamping pressure is supplied by a small-capacity, high-pressure pump which holds the clamp during injection.

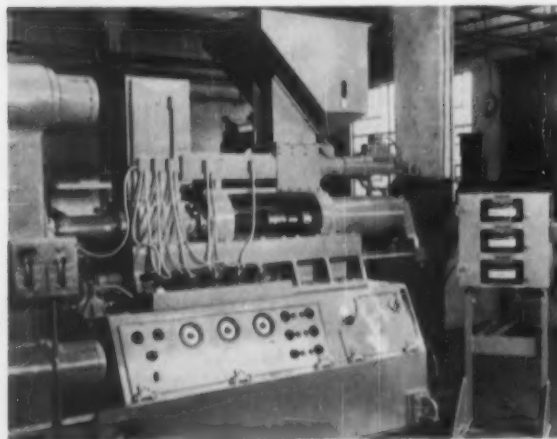
A summary of specifications of the W205 injection machine follows:

Capacity (acetate) oz./shot	160
Injection rate, cu. in./sec.	70
Max. injection pressure, p.s.i.	12,500
Pre-plasticizing pressure, p.s.i.	1,000
Hydraulic system pressure, p.s.i.	2,000
Platen size, in.	70 by 62
Mold height, in.	12 to 44
Mold stroke, in.	42
Injection plunger stroke, in.	16 3/4
Injection stroke speed, sec.	3
Drive motor, hp.	100

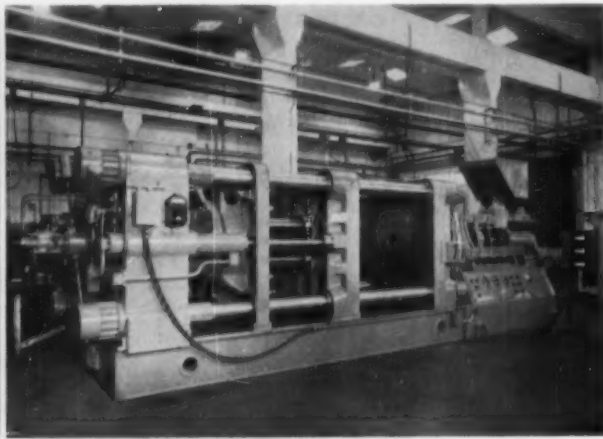
Other features include hinged filters in the oil reservoir and a maximum use of valves which reduces the required amount of high-pressure pipe. R. H. Windsor Ltd., Chessington, Surrey, England.

**Polyurethane Processing Equipment** — Conveyorized, double-head polyurethane slab cutter converts urethane slabs into sheets and rolls. The cutter operates as follows:

An 84-in. wide conveyor belt feeds the big slabs of polyurethane to two vertically adjustable splitting heads which face each other in the center



Close-up of injection and pre-plasticizer end of Windsor W205



Over-all view of Windsor W205 injection machine with pre-plasticizer

MODEL  
H-250



## Step Up Production with

## VAN DORN 2½ Oz. Automatic Press

Check these outstanding features of this ultra-modern Van Dorn injection press:—

**GREATER CAPACITY**— Up to 2½ oz.; smaller pieces at faster cycles.

**HI-SPEED PERFORMANCE**— Plasticizes material at 22 lbs. plus per hour.

**FASTER PRODUCTION**— Will attain up to 720 cycles per hour (dry run).

**HIGHEST EFFICIENCY**— Due to water cooling of injection plunger, transfer hopper and oil cooler.

**ACCESSIBILITY**— Due to simple platen clamp device for purging to change material or color.

**MORE SAFETY**— Mold hydraulic mecha-

nism makes press non-operative unless molded part is completely ejected.

**SIMPLER OPERATION**— Due to automatic, adjustable material metering device.

**MULTIPLE OPERATIONS**— Minimum operator attention by use of larger hopper and light that indicates when press needs attention.

**SELECTIVE CONTROL**— Merely throw toggle switch to operate press semi-automatically.

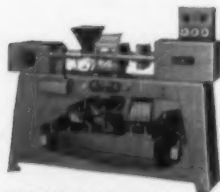
**DEPENDABILITY**— Because of all-steel construction and Van Dorn's established reputation in the plastics machinery field.

### THE VAN DORN IRON WORKS CO.

2687 East 79th Street • Cleveland 4, Ohio  
Cable Address: "VANDORN" Cleveland

**and this Van Dorn model is the lowest priced press in its class!**

Write for complete data on Model H-250 and other equipment shown. **FINANCING AVAILABLE**



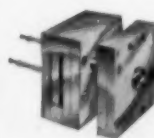
SEMI-AUTOMATIC PRESS  
2-oz. capacity.



POWER OPERATED, LEVER  
CONTROLLED PRESSES  
2-oz. and 1-oz. models



PLASTIC GRINDER  
Grinds up rejects,  
waste, etc., for re-use.



MOLD BASES  
Available from stock.

**GERING ..... MOLDING POWDERS ... for GREATER PRODUCTION**

# CUSTOM COMPOUNDING OF all plastics

If your facilities are crowded, or your THERMO-PLASTIC products require special processing techniques, it will pay you to talk to GERING before investing in production machinery.



The PLANT BEHIND the PRODUCT

**W**E are completely staffed with Laboratory, Technical and Engineering personnel; and equipped with BANBURY MIXERS — MILLS — EXTRUDERS — GRINDERS — PELLETIZERS — BLENDERS — BAGGERS and MATERIALS HANDLING EQUIPMENT to produce under your label large quantities of molding and extrusion compounds in any formulation of all thermoplastics, including POLYETHYLENE, VINYL, NYLON, ACRYLIC, CELLULOSE ACETATE, BUTYRATE, ETHYL CELLULOSE, POLYSTYRENE and its COPOLYMERS.

... and behind our plant, equipment, production and personnel are 31 years of learning HOW.

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KENILWORTH, N. J.

Conversion Specialists • Plastics Raw Materials  
"PIONEERS IN MODERN PLASTICS FOR OVER 30 YEARS"

Producing **PLASTIC PARTS**  
for Industry since 1876



Put Auburn's engineering "know-how" and production facilities to work producing plastic parts for your product! Backed by 78 years experience!

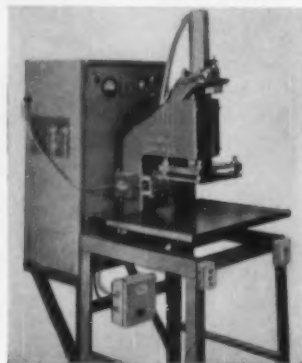
### Our Diversified Facilities Include:

- Compression, transfer and high-speed plunger presses up to 600 tons capacity.
- Extrusion machines up to 4½" screw size.
- Automatic rotary presses.
- Injection machines up to 22 oz. capacity.
- Vinyl dry blend compounds.
- Finer-textured, more uniform styrene sheets now available up to 51" wide ... up to ¼" thick. Any color.
- Tool and die shop • Engineering services.

## AUBURN BUTTON WORKS, INC.

Main Office and Factories Auburn, New York

**NEW!**  
**LOW-COST!**  
**HIGH**  
**POWERED!**  
**3 KW ELECTRONIC**  
**HEAT SEALER**



Model 300-SB25

**SEALOMATIC** presents a really new design in electronic heat sealers—a 3kw sealer that uses a 4kw tube to give you plenty of reserve power. This machine has 135% power capacity! Simplified design eliminates any need for a skilled operator. And best of all, the cost is surprisingly low!

### CHECK THESE SEALOMATIC 3KW ADVANTAGES:

- No tube failure ... plenty of reserve power (output tube actual rating is 4kw!)
- Fast, full timing control
- Simple, safe "one-knob" power control
- Dies changed in only a minute
- Dies protected by ARC-GUARD, Sealomatic's exclusive arc suppressor ... automatically synchronized to sealer action with no need for tuning!

Write or phone for catalog and additional information about this new, low-cost sealer. Be sure to ask about our free trial offer!

## SEALOMATIC ELECTRONICS CORPORATION

Dept. M, 429 Kent Avenue, Brooklyn 11, New York  
EVergreen 8-9413

In Canada: Montreal 2400 Rue St. 1163 Jean J. Labelle, Montreal, Quebec

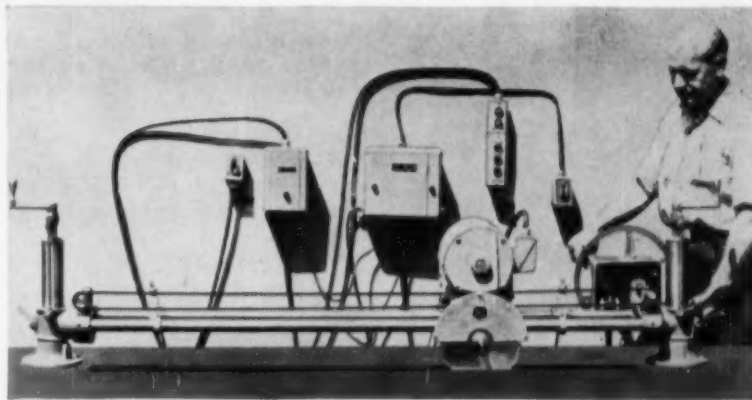
of a 14-ft. conveyor. These heads automatically adjust themselves to meet the stock as it moves back and forth on the conveyor belt. They split the stock to a predetermined thickness,  $\frac{1}{8}$  in. or more. As each cut is made, the split sheet is conveyed to one of two roll-up units. The cutting process continues until the slab has been converted into sheets and only the bottom skin of the original slab remains.

According to the manufacturer, the machine will handle blocks of urethane 25 ft. long, and longer when conveyors are placed at each end of the conveyor belt. Slab stock moves along the conveyor at speeds that are adjustable between 13 to 60 ft./minute.

A second machine being offered is a splitter-leveler. This machine is designed to level slabs of polyurethane over 10 in. high by making cuts off the top until the slab is perfectly level. Then an operator, stationed at an unload position at the rear of the machine, runs the machine by push-button control while it splits the slab into sheets of predetermined thickness. The machine includes a mechanism which moves the table up and down automatically and synchronizes table movement with the cutting blade, producing successive cuts without stock being handled. *Falls Engineering and Machine Co., Cuyahoga Falls, Ohio.*

**Roll Handling Equipment—Model 54** shaftless backstand is designed for unwinding heavy rolls at high tensions and fast speeds. It is built for operation at 1500 ft./min. with rolls up to 3500 lb., and 42 in. in diameter. Web tensions up to 10 lb./lineal in. are said to be obtainable. Rolls are lifted from floor to running position by push-button control. Chucking of rolls is also done by push-button control. The backstand is available with ribbed chucks for 3- to 6-in. I.D. paper cores as well as chucks for iron cores. *The Black-Clawson Co., Dilts Machine Works Div., Fulton, N. Y.*

**Panel Saw—Fully automatic panel saw** (which may also be operated manually) sizes and trims plastic, plywood, and metal sheet stock. Available in capacities from 4½ to 12½ ft., and with motors up to 3 hp., the saw provides automatic carriage speeds infinitely variable from 8 to



Hendrick's fully automatic panel saw sizes and trims plastic sheet stock; automatic carriage speeds are infinitely variable from 8 to 50 ft./minute

50 ft./minute. Cuts are made in full view of the operator. General Electric remote control stations, provided with 12-ft. cords, afford additional safety for the operator.

An adjustment that permits cutting on both passes is available. Manual operation, valuable in cutting very thick stock or in determining optimum cutting speed prior to setting up for automatic production cutting, is achieved by throwing a clutch. *Hendrick Mfg. Corp., Marblehead, Mass.*

**Compression Press—Model 100-2430-10** is a fully automatic press that handles phenolics, ureas, alkyds, Teflon, melamines, Glaskyd, gunk, and other thermosetting materials. The machine, said to meet all J.I.C. specifications, has a closing speed range of from 9.6 to 400 in./minute.

The hydraulic system is powered by an Oilgear duplex axial piston-type pump and the hydraulic reservoir is separate with a thermostatically controlled water cooling system. Drilled steel block valve manifolds are claimed to eliminate all flexible lines. All valves are gasket-mounted. The sump is raised overhead, level with the cylinder head. The two sump supports also double as ladders for service access to the overhead motor, pump, and valves.

Electrical controls are included as original equipment and provide for automatic feeding, automatic ejection, automatic flash cleanout, degassing, and deceleration. Potter and Brumfield throw-away type relays, incorporated—for the first time in machines of this type—according to

the manufacturer—are used in this press to permit quick change with minimum down-time. An emergency button permits returning the ram to the top of the stroke from any point in the cycle. Wheelco mold temperature controls are optionally available.

A safety device prevents damage to molds in case of ejection failure: the press closes at low pressure until it reaches a set limit switch, at which point it goes to high pressure. If there is an obstacle in the path, the limit switch will not be tripped and the press is thus stopped automatically.

Stroke of press is 18 in.; daylight, with fixed head, is 42 in.; over-all



Baker Bros.' compression press handles phenolics, ureas, alkyds, Teflon, melamines, Glaskyd, gunk, and all other thermosetting materials

height is 155 in.; and weight is 18,000 pounds. The top-mounted 60-sq. in. hydraulic cylinder (made in a single casting for rigidity) has a working pressure of 3200 p.s.i. to deliver 100 tons pressure, adjustable from 10 to 100 tons. The press can also be adapted to semi-automatic and manual operation. *Baker Bros., Inc., P.O. Box 101, Station F, Toledo 10, Ohio.*

**Extruders** — Available heretofore only with 2½-in. machines, cylinders and screws with 20:1 ratios (length/diameter) are now standard on all NRM Model 55 extruders.

This construction is claimed to provide more thorough heating combined with greater mechanical working of the plastic as it travels a longer path to the die. The physical characteristics thus developed in the plastic are claimed to result in extrusions of finer finish and better shape-holding qualities, produced 30 to 50% faster and with less waste than with conventional machines. *National Rubber Machinery Co., 47 W. Exchange St., Akron 8, Ohio.*

**Vacuum Forming Machine**—Low-cost Model 88-FM is a self-contained unit using a single heater to permit a single operator to handle drape forming and vacuum forming production runs simultaneously. The machine requires 28 by 90 in. of floor space, stands 54 in. high, and weighs 500 pounds. The machine is a modification of the Model 88, which is designed for straight vacuum forming.

Specifications for Model 88-FM are as follows:

Minimum mold size (in.) ..... 2 by 2  
Maximum mold size (in.) ..... 16 by 16

Platens size (in.) ..... 18 by 18  
Heater capacity (kw.) ..... 3½  
Heater size (in.) ..... 22 by 22  
Depth of draw (in.) ..... up to 6  
Vacuum pump (cu. ft./min.) ..... 3.0  
Surge tank capacity (gal.) ..... 15

Vacuum gage, surface-ground platens, timers for vacuum valve, and automatic cycle control of vacuum operation are provided. *Vacuum Forming Corp., 76 S. Bayles Ave., Port Washington, N. Y.*

**Tab Maker** — The Permaform Automatic is a machine for forming transparent 45° angle index tabs for file folders, dividers, or cards. The equipment processes die-cut blanks of transparent cellulose acetate sheet 0.010 in. thick. Maximum length of tab is 4 inches.

Two models are available: Model 143-E is designed for making tabs with 0.265- to 0.272-in. faces and ⅝-in. over-all height for eyelet mounting; this model is equipped with variable-speed electric motor, adjustable automatic temperature control for electrically heated forming dies, a loading gage adjustable for centering different lengths of blanks, two dial thermometers, and one extra mandrel for second-station feed. Model 143-C is designed for making tabs of 1-in. over-all height. *Taber Instrument Corp., North Tonawanda, N. Y.*

**Compression-Transfer Press** — Improved toggle-type, hydraulically actuated 150-ton press with a minimum opening and closing time of 2 sec. is particularly recommended for molding alkyds, although it is also claimed to be suitable for other plastics. The fast operation is ob-



Hull-Standard's compression-transfer press is equipped with sequence type dial-operated cycle controllers

tained through the use of high-speed differential cylinders which are four times as fast as those in previous models but have the same power requirements.

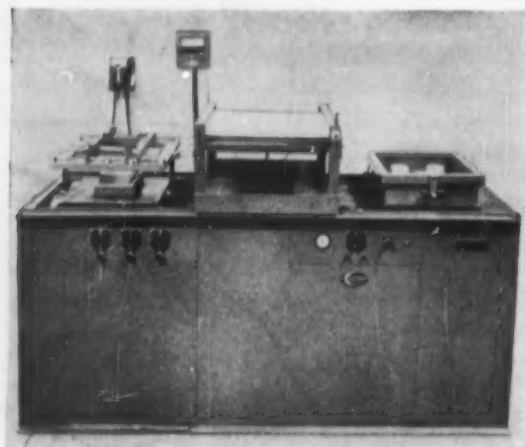
The press is equipped with sequence-type, dial operated cycle controllers. In compression molding, four vernier dials each control independently initial closing (including plasticizing time), mold opening for breathing, breathing period, and curing time. In transfer molding, control of pressure and speed of transfer ram, independent of clamping circuit, is provided. Toggle mechanism is enclosed and spray lubricated.

Provision for top and bottom ejection is made; the main cylinder is valve cushioned at both ends of stroke.

The press is available in these models: 250-C for compression molding; 258-C for transfer molding; and 259-C for combination compression-transfer molding. *Hull-Standard Corp., Abington, Pa.*

**Engraving Machine**—Scripta SR-3D is an engraving and copying machine designed for three-dimensional work on molds and dies, which can produce both relief and itaglio engravings.

Reproduction is achieved by means of a pantograph which can be adjusted for different scales of reduction. The spindle which carries the cutter is mounted on ball bearings and is adjustable for play; the spindle is direct-driven by a high-speed



Vacuum Forming Corp.'s Model 88-FM is designed for drape and vacuum forming operations to be performed on one machine using a single heater

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motor, and the spindle assembly is claimed to be free of vibration. The guide finger, which is mounted at the front of the machine and which traces patterns to be reproduced, is the only part of the machine which is manipulated by the operator. Table and base are of cast iron with ground surface tops. Setting lines are milled on the top of the table and a number of holes are tapped in it to permit easy location and fixing of components. Accessories available with the unit include the following:

Vices for fixing pieces of all shapes; attachment for engraving on curved and irregular surfaces; dividing head for circular engraving on cylinders, cones, and round plates; pyrographic attachment for engraving on hardened and unhardened steel; and diamond for engraving jewelry, glass, and the like.

Specifications for the SR-3D are as follows:

Scale of pantograph reduction  $\frac{1}{2}$  to  $\frac{1}{16}$   
Number of dimensions obtainable from same guide letter . . . . . 23  
Height of character (in.) . . . . .  $\frac{1}{32}$  to  $\frac{1}{8}$

Number of lines of text engraved in single operation . . . . . 6  
Surface covered in single operation at scale  $\frac{1}{2}$  (in.) . . . . . 15 $\frac{3}{4}$  by 9.8  
Diameters of cutter (mm.) . . . . . 4, 6  
Speed of motor (r.p.m.) . . . . . 13,000  
Voltage of motor (v.) . . . . . 220

Equipment supplied with machine includes electric motor, 6 cutters, 2 copy holding slides, 4 holding-down clamps, spanners, and instruction book. *Scripta Machines à Graver, 7, Passage Turquetil (Nation), Paris 11, France; U. S. agent: W. F. Machinery & Co., 2910 Santa Fe Ave., Los Angeles 58, Calif.*

**Weigh - Feeder** — Injecto-Weigh Series 700 includes automatic compensator, automatic pickup head, and remote control box.

The automatic compensator consists of a self-contained precision pickup and controls, so arranged that it functions only when there is too much material ahead of the ram. It does not interfere with the normal weighing operation of the feeder. When set for "no cushion," the compensator will act to reduce the

amount of weight in the shot, even if a cushion of only 0.001 in. develops. The compensator can also be set to maintain a specific cushion. This unit is said to compensate for short shots, prevent excessive build-up of cushion, etc.

The automatic pick-up head is reported to eliminate the need for Microswitches. It fits any injection molding machine.

The remote control box which is linked to the compensator, hopper vibrator, bucket gate, pickup, and other parts, is of the plug-in type.

The machine has a graduated beam for visual weight indication. A red light indicates that parts are too heavy. The weighing mechanism is of the parallel linkage type. Bucket gate is pneumatically operated. Positive cutoff is provided when predetermined weight has been attained. Supply hopper has adjustable neck for material in feeder trough. Manually operated purge switch opens hopper gate, manually operated make-up switch feeds plastic in excess of weight setting. *Glengarry Equipment Corp., Bay Shore, N. Y.*

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## West German Plastics Exposition

**A**TTENDANCE exceeding all expectations and terrific commercial interest were features of "Plastics 1955," the West German plastics industry show in October. There were 242,000 visitors to the show, of which some 25% were from abroad. And there were 346 exhibitors.

The show reflected the tremendous recent growth of the West German plastics industry, which registered a 36% increase in output of raw materials in 1954 over 1953. This makes West Germany the world's second largest producer of plastic materials, topped only by the United States.

The show also reflected the increasing transfer of know-how and growing trade among elements of the plastics industry throughout the whole free world.

From American visitors to the exposition, **MODERN PLASTICS** learns that the layout of the exhibition was splendid, that the booths were fabulous, and that the show management was effective. However, a number of visitors commented that in their opinion the opening of the exhibit to the public created a considerable nuisance for those people who were trying to do business and to find out about equipment and materials. Further comment is to the effect that if the exhibit had been confined to trade and industry only and had been open one evening to the public—as is done at the National Plastics Exposition in the United States—industry visitors from all over the world would have been able to make better use of their time.

An innovation was the setting up of two large instructional exhibits, one entitled "From: Material to Shape" and the other entitled "The Very Best Made of Plastics." The first was concerned with fabrication of materials; the second with quality applications. Quite a lot of attention was given to the polyurethane foams, the vinyls, and the polyethylenes.

Among the papers presented at the adjunct meeting, which was organized by the Technical Committee on Plastics of the Association of German Engineers, was one on the "Manufacture of Plastic Dies" by Dr. Reinhard Walter. This paper dealt chiefly with the use of P.V.C.

pastes and compounds in the manufacture of elastomeric molds in which phenolics, epoxies, and polyesters may be cast to produce tools for vacuum forming and for low-pressure molding.

Another paper by Dr. Paul Weisert dealt with "Plastics in the Construction of Models," and illustrated economical and speedy methods for producing models later to be molded in mass production out of some plastic.

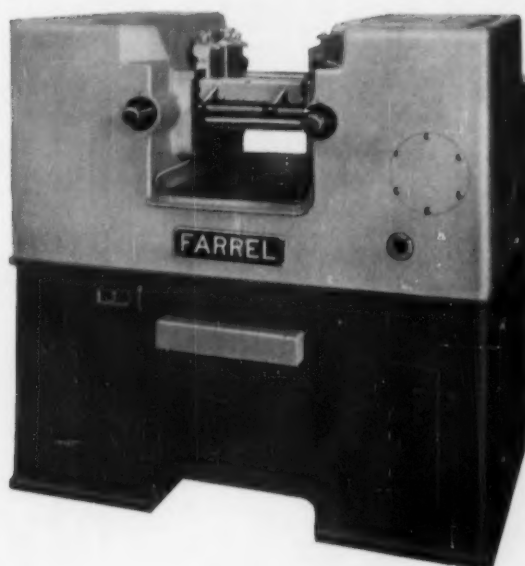
"Machine Elements Made of Laminated and Molded Plastics" was a paper presented by Ing. Walter Hensky. Mr. Hensky dealt with thermoset materials used as machine components, either compression molded or tooled from laminates. The other side of the picture was presented by Dr.-Ing. H. R. Jacobi who dealt with "Machine Elements Made of Thermoplastic Materials." He pointed out that it is important to use thermoplastics where the elements will not be exposed to great mechanical stresses.

As to the European equipment on display, American visitors interviewed by **MODERN PLASTICS** on their return were impressed with the variety and extent of plastics machine production as displayed at the exposition but were in general rather unimpressed with the attitude of the European machine manufacturer toward mass production, automation, and controls. More than one of these visitors to the Fair has stated that the much higher costs of labor in the United States, the general lower costs and ready availability of materials, and the necessity of mass production to serve mass markets has caused American plastics machinery manufacturers to forge ahead on points of speed, controls, and instrumentation. A further comment by American visitors was to the effect that European machine tool workmanship was exceptionally fine.

Two pleasant features aside from the exposition but occasioned by it were a dinner given for German and American plastics industry leaders by William Cruse, executive vice president of the S.P.I., on October 10 and a cocktail party tendered by leaders of the German plastics industry the following day.

Battelle Memorial Institute  
Bauer and Black  
Division of the Kendall Company  
Godfrey L. Cobot, Inc.  
Celanese Corporation of America

## Here are 30 VOTES OF APPROVAL for Farrel's "new-style" LABORATORY MILL



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E. I. Du Pont De Nemours & Co., Inc.  
Durez Plastics & Chemicals, Inc.  
Esso Research & Engineering Co.  
Esso Standard Oil Co.  
General Electric Company  
General Tire & Rubber Co.  
Harshaw Chemical Co., Inc.  
Interchemical Corporation  
Johns-Manville Research Center  
The Kerite Company  
Koppers Company, Inc.  
Linde Air Products Co.  
Merck & Co., Inc.  
Monsanto Chemical Co.  
The Okonite Co.  
Proctor & Gamble Co.  
Remington Arms Company, Inc.  
Shell Chemical Corporation  
Spencer Chemical Co.  
U. S. Rubber Company  
University of California  
R. T. Vanderbilt Co., Inc.  
Western Electric Co.  
Westinghouse Electric Corporation  
Witco Chemical Co.

Method of Speed Control	No. of Motors	HP Each Motor	Friction Ratio	Roll Speed (RPM)	
				Front	Back
Constant	1 (AC)	7½	1.4:1	23.5	33
Vari-pitch Pulley	1 (AC)	7½	1.4:1	13 to 24	18 to 34
Vari-pitch Pulleys	2 (AC)	5	Variable	20 to 38	18 to 34
Adjustable Voltage	2 (DC)	5	Variable	4.5 to 34	6 to 45

You can get an idea of the popularity of Farrel's two-roll, 6" x 13" lab mill from that *partial* list of users. A number of these big names in industry have sent in repeat orders for one or more additional mills.

One reason for this wide acceptance is that, in standard form, the mill comes with four different drive arrangements (see chart). One of these should give *you* exactly the roll speed or speeds, and friction ratio you need for experimental work.

Another reason is that, although these mills are basically standard, they can be tailored to suit any manufacturer's requirements with the choice of many design features.

Send for further information about this versatile mill, or ask to see a Farrel engineer about your laboratory equipment problems.

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DOWNTOWN, PA.

## PLASTICS AND SYNTHETIC RESIN PRODUCTION

From Statistics Compiled

Materials	Total p'd'n first 9 mos. 1955	Total sales first 9 mos. 1955
<b>CELLULOSE PLASTICS:</b> <sup>a</sup>		
Cellulose acetate and mixed ester		
Sheet, under 0.003 gage	14,010,033	13,991,092
Sheets, 0.003 gage and over	11,147,684	10,789,022
All other sheets, rods, tubes	5,728,394	5,317,100
Molding, extrusion materials	67,243,645	65,750,532
Nitrocellulose sheets, rods, tubes	3,574,639	3,724,012
Other cellulose plastics	4,408,528	3,987,817
<b>PHENOLIC AND OTHER TAR- ACID RESINS:</b>		
Molding materials <sup>a</sup>	154,122,966	143,379,239
Bonding and adhesive resins for:		
Laminating (except plywood)	46,973,988	37,351,230
Coated and bonded abrasives	37,528,003	28,442,793
Friction materials (brake linings, clutch facings, etc.)	18,954,911	17,224,945
Thermal insulation (fiber glass, rock wool)	36,299,220	36,563,301
Plywood	29,443,580	23,964,748
All other bond and adhesive uses	15,825,392	15,942,618
Protective-coating resins	19,362,844	18,714,974
Resins for all other uses	26,988,587	24,606,979
<b>UREA AND MELAMINE RESINS:</b>		
Textile-treating and textile-coating resins	30,256,646	29,179,505
Paper-treating and paper-coating resins	16,261,667	15,855,538
Bonding and adhesive resins for:		
Plywood	71,952,505	68,203,676
All other bonding and adhesive uses, including laminating	20,694,334	20,569,970
Protective-coating resins	28,299,715	21,713,698
Resins for all other uses, including molding	58,553,047	58,857,177
<b>STYRENE RESINS:</b>		
Molding materials <sup>a</sup>	301,248,056	276,196,680
Protective-coating resins	73,919,309	68,941,152
Resins for all other uses	69,999,515	61,162,481
<b>VINYL RESINS, total<sup>b</sup></b>		
Polyvinyl chloride and copolymer resins (50 percent or more polyvinyl chloride) for:	512,439,446	477,770,038
Film (resin content)		62,650,806
Sheeting (resin content)		37,486,682
Molding and extrusion (resin content)		132,764,193
Textile and paper treating and coating (resin content) <sup>a</sup>		45,806,777
Flooring (resin content)		41,828,840
Protective coatings (resin content)		21,022,393
All other uses (resin content)		36,311,233
All other vinyl resins for:		
Adhesives (resin content)		24,003,233
All other uses (resin content)		78,895,880
<b>COUMARONE-INDENE AND PETROLEUM POLYMER RESIN:</b>		
	193,057,255	192,715,648
<b>POLYESTER RESINS:</b>		
For reinforced plastics	38,433,399	32,568,335
For all other uses	2,540,834	2,483,183
<b>POLYETHYLENE RESINS:</b>		
<b>MISCELLANEOUS:</b>		
Molding materials <sup>a, d</sup>	121,257,475	93,133,445
Protective-coating resins <sup>a</sup>	3,262,905	2,018,245
Resins for all other uses <sup>e</sup>	74,367,838	74,018,314

<sup>a</sup> Dry basis designated unless otherwise specified.

<sup>b</sup> Partially estimated. <sup>c</sup> Revised.

<sup>d</sup> Includes fillers, plasticizers, and extenders. <sup>e</sup> Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. <sup>f</sup> Includes

**IN POUNDS\* FOR AUGUST AND SEPTEMBER 1955**  
by U.S. Tariff Commission

August**		September**	
Production	Sales	Production	Sales
1,512,198	1,403,540	1,885,671	1,824,280
1,236,903	1,209,679	1,422,689	1,366,088
641,203	569,659	703,351	755,538
7,680,778	7,423,559	8,728,142	8,852,976
412,698	451,359	395,830	394,766
332,270	220,747	429,521	439,780
17,887,677	16,455,707	18,166,954	16,465,362
5,583,255	4,417,098	5,823,224	4,723,104
1,099,595	1,255,971	1,370,881	1,468,037
2,042,808	1,808,171	2,230,367	1,992,004
4,512,045	4,533,092	5,171,730	5,316,570
3,285,710	2,731,196	3,857,249	3,407,927
2,191,620	2,266,414	2,334,632	2,381,168
2,070,024	1,926,552	2,481,274	2,196,678
2,484,531	2,452,753	3,266,411	2,594,720
3,154,619	3,037,256	3,410,196	3,467,489
1,984,249	2,096,572	1,965,747	2,104,952
18,519,521	18,926,025	9,031,452	8,395,640
2,503,376	2,516,751	2,727,023	2,322,257
3,338,941	2,422,789	3,258,472	3,038,263
6,254,207	6,726,921	7,146,022	7,725,939
33,931,323	31,068,927	35,057,204	31,893,789
8,317,078	7,553,167	8,002,658	7,613,842
7,212,391	7,053,522	15,246,994	8,299,659
57,022,155	51,367,134	60,967,888	55,381,793
	6,477,682		6,982,807
	3,358,999		4,166,209
	13,265,299		15,412,328
	5,135,925		5,582,234
	4,599,162		4,707,365
	2,104,670		2,313,374
	4,758,970		4,016,903
	2,867,758		3,071,897
	8,798,669		9,128,676
122,613,557	122,874,389	23,599,090	23,748,913
4,446,431	3,892,570	3,803,282	4,010,947
293,151	147,725	289,239	188,338
33,188,819	31,176,698	37,214,859	30,613,517
3,609,175	3,248,389	4,541,205	4,243,482
1266,977	1208,407	381,485	233,562
6,346,606	6,313,829	6,873,682	6,476,407

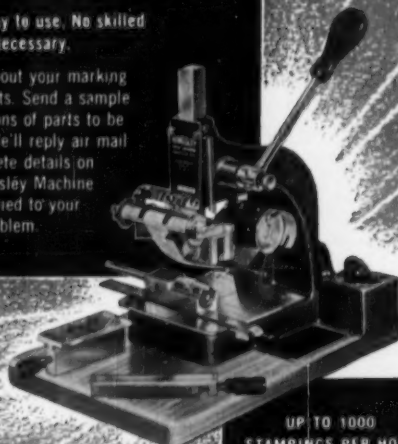
data for spreader and calendaring-type resins. \*Includes data for acrylic, polyethylene, nylon, and other molding materials. †Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins. ‡Includes data for acrylic resin modifications, nylon, silicone, polyethylene, and other plastics and resins for miscellaneous uses.

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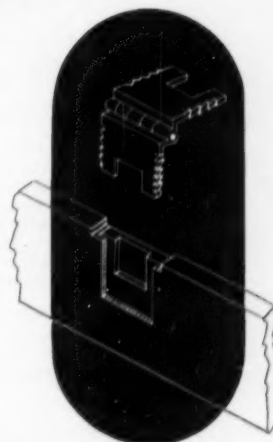
a drive-screw)

with

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## Phenolics

(From pp. 79-84)

still equipment to make it useful—and this step is expensive and time-consuming. But a bright future for shell molding is just as assured as it is that Notre Dame will win another football game.

An authority who certainly ought to know what's going on in the field estimates the total amount of all resins used in foundry casting, including core and shell, to have been between 8 and 10 million lb. in 1954. He thinks the 1955 figure was well over 10 million lb., but refuses to be pinned down to an actual figure. He admits that resin volume for core molding may have even exceeded the amount used for shell molding but, if so, he predicts that the percentage will soon change. He also believes that over 15 million lb. will be used in 1956 and over 20 million in 1958. And it is estimated that by 1961 the total may reach 50 or 60 million pounds.

During the past year, several plants have installed complete equipment for core and shell molding. Among them are independent firms who will, theoretically at least, spread the doctrine of shell molding superiority over a broader base than will the captive plants. Competitors will sooner or later have to follow or be outmoded insofar as at least part of their production is concerned.

**Largest List of Customers**—The list of foundry customers is one of the largest in the plastics industry, but most of them use so little resin that it is difficult to service them. About 500 plants claim they are producing shell castings, but each machine in service uses very little resin. Whether or not this host of small accounts can be built into something big is questionable, but phenolics suppliers seem satisfied that a number of large-volume users will grow up among them in the years to come.

The big captive plants, largely automotive, have also expanded their shell molding facilities. General Motors, for example, will soon have three times as much shell molding capacity as it has now. One enthusiast believes that the auto companies will have developed the process sufficiently to be able to

"pour" entire automobile engines by the shell molding technique in a few years' time.

No one expects shell molding to take over the entire foundry casting business. There will always be various methods of operation. And some companies, such as Chrysler, prefer forging rather than casting. Nevertheless, the potential market for resin in this field is big. The ballyhoo back in the early '50's was premature and still more time is needed to develop a large volume of sales, but shell molding resins should never be put in the class of the big balloon that blew up before it left its moorings.

**Substantial Miscellany**—The miscellaneous classification in Table II, p. 80, is difficult to separate into parts. It's a good substantial item, but made up of a myriad of small volume items. One is phenolic foam, which is foamed in place and used for packaging fragile items such as glassware. An odd use is the applicability of such foam as a humidifying brick in cigar counter cases.

Microballoons is another item in "miscellaneous." Its use to prevent evaporation in oil tanks has been proved, but field testing requires years of experimentation. Furthermore, it is expensive, but there seems little doubt that expenditure of a few thousand dollars for Microballoons can save millions of dollars in lost petroleum. There is also a possibility that Microballoons can be used to prevent gasoline evaporation at some not too distant future date—if so, the market should certainly zoom upward.

Resin for reinforcement of rubber used in shoe heels and elsewhere is also in "miscellaneous." If it is big-volume the producer has certainly succeeded in keeping that fact well masked.

Resin for sale to users who make their own molding compounds is another question mark which appears in this list.

Probably the largest volume use in this classification is casting resin. There is very little of the old fancy, bright colored material used for decorative effects since that market succumbed to thermoplastics, but there is an estimated 150 to 200 thousand lb. a month being used for making tools or molds that are widely used in the automotive and aviation industries.—END

*To mold these...*

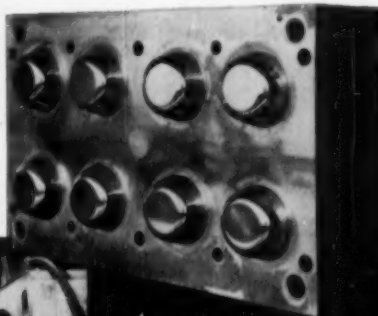
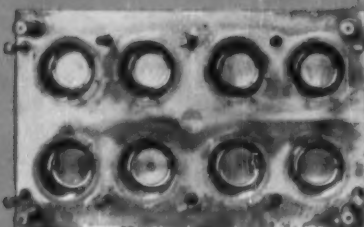
Peoria Plastic Co., East Peoria, Ill.

*Selected...*

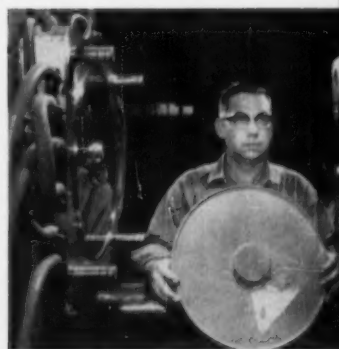
# Cascade

prehardened MOLD STEEL

*for these molds...*



Eight cavity, center-gated, three plate mold that manufactures twelve ounce polystyrene bowls in an overall twenty-two second cycle.



Single cavity, two-plate mold for "Lazy Susan" turntables. Contains approx. 200 square inches of projected area with material injected at approx. 16,000 lbs. per square inch with a clamp pressure of 400 tons. Mold operates on overall cycle of forty-five seconds.

*Because...*

As noted by Peoria Plastic Co., the qualities found in Cascade prehardened mold steel are typical of the comments from many plastic molders everywhere. Cascades uniform hardness, outstanding finishability, plus ready weldability are the result of Latrobe's exclusive precipitation hardening metallurgy and produce the steel you need for high quality molds.

Order prehardened Cascade for your next mold—large range of stock sizes are available from conveniently located warehouses.

1

Cascades uniform hardness throughout the entire section was needed for the depth of both the cavities and cores.

2

Cascade polishes faster and the lustre comes up higher.

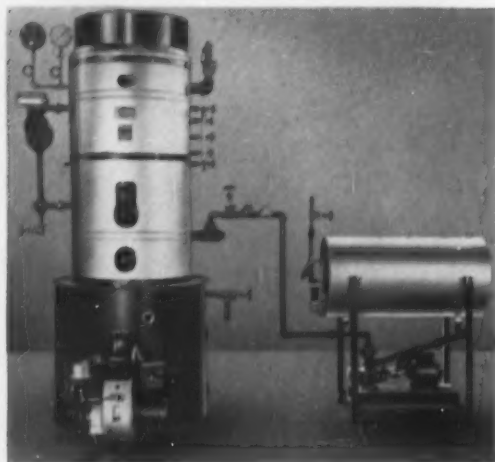
3

Long wearing characteristics of Cascade produced approximately three million parts without breakdown at the cut-off.

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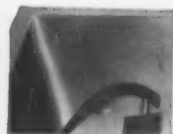
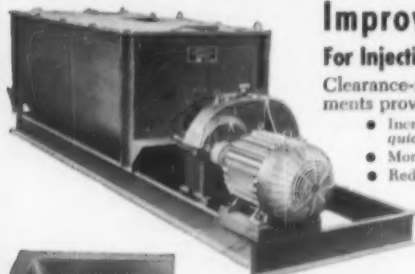
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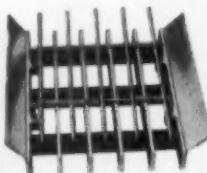
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**R. N. BAILEY & CO., INC.**

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## Phenolic Laminates

(From page 84)

World War II and has even brought new companies into the business who were never involved in laminating before the advent of decorative laminators in business today who produce nothing but decorative laminates. A 100 million-lb. volume for decorative laminates is a goal that may not be too far away.

**Rise in Industrials**—The spurt in industrial laminates is generally attributed to the rise in all business activity—in other words, laminate users are demanding more of the same thing they have always been using. Laminated timing gears, for example, are in more demand by the automotive and aviation industry. Automotive timing gears each weigh 1 lb. or more; they consumed over 7 million lb. of plastics in 1955.

The evolution of printed circuits has also been a boon to the industry, since a laminate seems to be the most satisfactory base yet devised. Printed circuits appear destined to grow at a rate that defies estimation. The tendency toward automation and miniaturization will undoubtedly create a market for printed circuits that is impossible to measure at this date. In addition, there are the radio and television markets; several producers are already using them.

**Cold Punching**—Some time has been required to develop a satisfactory laminate for printed circuits because it must be punched cold, and such stock had to be specially developed. However, suppliers are now furnishing resin that gives cold flexibility to the finished sheet without sacrifice of electrical properties.

Laminators, in general, are a happy lot these days in contrast to their position in the early 1950's when many of them were singing the blues. They still claim that they could handle more business but there are few if any cold smokestacks among their plants. They are also adding new equipment in sizable quantity. New, large presses (4 by 10, 4 by 12, and at least one 5 by 12 ft.) have been installed in contrast to the older machines that were never over 4 by 8 ft. and mostly of the 3- by 7- and 3- by 6-ft. variety.—END

Modern Plastics

## Cellulosics

(From pp. 85-88)

ing them together in a transparent skin-tight package is one of the neatest packaging devices that has come along for many years. In addition to the increasing use of this type of display, an encouraging factor for acetate is that some processors are now using only acetate or butyrate for the job—that is, the use of a cardboard backing can often be obviated in favor of a 100% plastic package that has more strength and improved appearance. One firm has installed a completely continuous, automatic operation whereby they start with acetate extrusion material, extrude it, vacuum form, and fabricate the finished box all in one pass through the production line.

**Automatic Forming**—Another aid to the increasing use of acetate for packaging has been the recent introduction of a vacuum forming machine that is completely automatic. A roll of film is placed on one end of the machine and comes out in completely finished form at the other end with no hand labor involved.

Acetate is, of course, ideal for this tremendously fast growing visual packaging trend because of its clarity and strength. The future is most promising. One new test that could eventually mean heavy poundage for acetate is an electrical company's apparent intent to encase its small light bulbs in a blister pack of 5- to 7½-mil acetate film. There are as many as 50 to 60 million bulbs involved in the trial. If it works in small bulbs, larger ones will be packaged in a similar form.

**Tomatoes in Acetate**—Another test is for tomatoes, where a complete package with each of four tomatoes packed in a separate acetate blister is being tested on a 500,000 unit experiment. If tomatoes can be handled in this manner, other fruits and vegetables will follow.

The evolution from counter sales to self-service has been a first-rate promotion for plastics, especially acetate and polyethylene. It is no wonder that acetate producers conservatively guess that sales of their material in 1956 will be at least 10% more than in 1955.—END

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Size	O.D.	Length
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## Acrylics

(From pp. 88-89)

sort of thing indicated that even if one plastic had it all, the total poundage would be far under the hundreds of millions of lb. frequently associated with this idea. In other words, it's a nice market, but no breath-taking phenomenon. Methacrylate has all the properties except that of cost to be dominant in this field. But higher cost generally implies quality and for that reason several lighting fixture manufacturers are concentrating on methacrylate ceiling diffusers and similar items.

In other lighting fields, particularly outdoor, methacrylate is moving ahead. Wherever fluorescent lighting is used, a methacrylate shield is required. Around filling stations and shopping centers one will nearly always find methacrylate in the outdoor lighting arrangement.

Methacrylate is not particularly fitted for incandescent lighting since the heat build-up could cause distortion. However, more and more street lighting systems are employing fluorescent type lights and thus increasing the possibility of using methacrylate.

**Glazing**—There are many persons who believe that the largest future for methacrylate sheeting could be in glazing. It has the wearing and weathering properties to fit the job. It might also be used as a skin over rigid urethane foam or as a facing on plywood for structural purposes. Some day it could well "cash in" on the promotion job that has been done for polyester-fibrous glass corrugated sheeting for awnings, partitions, and the like. An interesting angle in this connection is that a small portion of methacrylate monomer is now being used with one company's polyester resins in order to improve weathering.

Methacrylates have always been a comparatively high cost plastic because of high priced raw materials. That price has in turn prevented big volume use as compared with several other plastics. The cost of methacrylate monomer ingredients has always been considerably more than the maleic, phthalic anhydride, and styrene used in polyester resins for the reinforced plastics industry. Furthermore, the ex-



*The luminous panels of a Montreal boardroom. Photograph by courtesy of Canadian Industries (1954) Ltd., Montreal.*



*'Perspex' street lighting fittings in Australia made by The General Electric Co. Ltd., London.*

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OFF. 40

pense in setting up a methacrylate extrusion or casting operation is more than that involved in setting up a plant for production of reinforced plastics glazing. The low cost of setting up a plant tempted scores of individuals to set up small reinforced plastics plants in all parts of the country. They have flooded the nation with their product and engaged in price wars to move their production. Methacrylate sheet producers have scarcely moved a finger to compete in this fast growing market, but they may soon do so.

**Better Techniques**—In the first place, improved and faster extrusion techniques are on the way. In the second place, acrylate monomer prices are on the way down. They have dropped from 48 to 49¢ in 1949 to 34 to 37¢ at present. Most of the reduction came in the last two and one-half years since a new acetylene process was installed for production of materials used in the monomer. All signs indicate that methacrylate production volume can be increased rapidly if needed. More production and more use generally result in lower prices. The cost will never

be low enough to compete price-wise with many other materials in the same market, but it may become low enough to compete more strongly for volume quality jobs.

Acrylates, (acrylic esters) the third member of this acrylic family, are still in the infant class compared with methacrylate. But they have so many possibilities that future growth in large quantity seems certain.

For several years, they have been used primarily as an impregnant or in emulsion form for coatings or surface treatment of paper, leather, and other materials. In most cases, a film is deposited upon the treated surface from an emulsion. Most of the acrylate resins thus used are in copolymer form—the monomer alone is too soft or tacky.

**Vinyl Plasticizer**—Some acrylates are already in use as a copolymer with vinyl chloride. The best of the lot is probably 2-ethyl hexyl acrylate which is claimed to be the ultimate in plasticizing efficiency as far as internal plasticization is concerned. It improves flexibility and cannot spew.

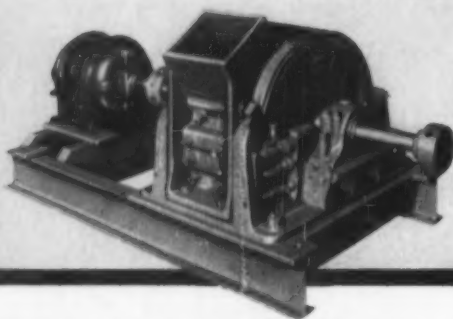
An important consideration is that

these acrylates are now approaching the more generally used plasticizers in the price scale. They have seldom been practical for this purpose from an economic viewpoint in the past.

**In Paint**—The largest use and perhaps the most promising for acrylic emulsions is in paint. A large mail order house carried acrylic paints in 1954. A large paint producer has now added them and others will almost have to follow.

Acrylic paint is without odor. It can be used on wood, masonry, cinder block, wall board, and most any other surface indoors. Under many circumstances, it can be used outdoors—even on old, painted surfaces. It dries so fast that two coats can be applied during one scaffold setting. A testimonial to its efficiency comes from a New York hotel where it was applied on the hostelry's "cold room" and hasn't cracked a year after application. Other paints simply wouldn't stay on the wall. Of course, the finished paint costs around \$1.00/gal. more than conventional paint, but its performance cuts maintenance cost to make up more than the difference.—END

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## Polystyrene

(From pp. 89-92)

chart on p. 90. How long this export business can keep up is a question. Polystyrene plants are now under construction or already in operation in many foreign countries. They should soon be able to take care of a great portion of the overseas demand.

**Copolymers**—Styrene copolymer resins are thought to account for some 30 million lb. of the total molding powder volume. They are growing slowly but gradually. There must be millions of C-11 drinking tumblers in service around the country. Over 3 million lb. of Kralastic are thought to have been used for pipe in 1955. Cyclocac has taken over an important application in one television manufacturing plant. Plio-Tuf is beginning to make its mark as a tough, durable sheet material, and Royalite and Boltaron sheets are now in big scale applications in automobiles. There are numerous other uses for these materials, but the above are the headlines.

There have been no particularly sensational developments in resin improvement over the past year compared with other years when high-impact, greater heat-resistant, and better light-resistant materials were brought out. There is a story from Europe that an Italian company is attempting to develop a polystyrene by a new catalytic system with a 380° F. distortion point, but commercial production is thought to be years away.

**Steady Improvements**—However, there have been so many steady improvements since 1945 when polystyrene became commercially available on a fairly large scale, that the public would scarcely recognize that original one-purpose material if they found it today. Goaded on by the need for a variety of resins that would minimize complaints regarding brittleness, yellowing, poor heat resistance, and at the same time fit special purposes, the producers have continuously kept coming up with improved varieties until polystyrene has become a real utilitarian material that can be used in scores of applications where the original material would have been a rank failure.

**Various Formulations**—There is

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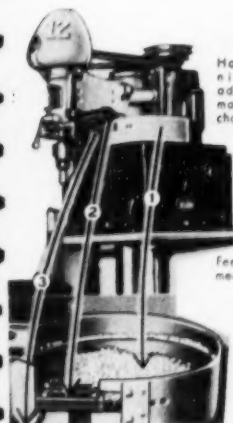
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**Notable Achievements**—In all the excitement and delirium of this plastics world, many folks have overlooked what's been happening to polystyrene during the past few years. It's about time someone raised a loud voice to proclaim its achievement. A 40% gain since 1950 is something to talk about. Furthermore, the gain is based on a good, solid 268 million lb. in 1950; it's quite different from those plastics materials which claim "fantastic" growth but start their percentage base from zero.

**Protective Coatings**—Styrene-type protective coating resins listed in Table VI, p. 91, benefitted particu-

larly from the national housing programs. This material has grown from almost nothing in 1949 to 30 million lb. in 1951 to its present high estate. Somewhere near 80 million of the 90 million lb. total is for styrene-butadiene latices. Six-sevenths is for paint. The balance is used for the production of paper coating and styrenated alkyds.

The styrene-butadiene resins are used at a rate of from 1¼ to 2.2 lb./gal. of paint. Resin manufacturers of this material claim their competitive position is still A. There is some competition developing from vinyl acetate for interior paints, but the latter costs 7 or 8¢ more on a pound-volume basis because it is heavier. The acrylate paints are about 42¢ a lb. for resin on a dry basis, compared with 30¢ for styrene-butadiene. In a gallon of paint the difference to the consumer is about \$1.00.

Attempts to use straight styrene latex for paints have not yet proved out for practical purposes.

**Other Uses**—Styrene resins for "other uses" in Table VI, p. 91, include several products, but infor-

mation concerning some of them is vague. The small increase noted in 1955 is more significant than it looks since polyester resins are no longer included in this listing and they accounted for over 30 million lb. in 1954. Best known in this classification are the high-styrene-butadiene resins used for rubber reinforcement in shoe soles, mechanical goods, and floor coverings. The amount so used is probably 15% over 1954, but still under 30 million pounds. The increase was created by the exceptional activity in production of all types of rubber goods during 1955.

Styrene monomer production was about a billion lb. in 1955 compared with 703 million in 1954. Styrene-type resins (exclusive of polyesters) required somewhere around 480 million pounds. If GR-S rubber production went as high as 800,000 tons, it would have required about 400 million lb. of styrene monomer. Not many people back in 1950 would believe that the plastics industry would require more monomer than rubber within the short period of five years' time.—END

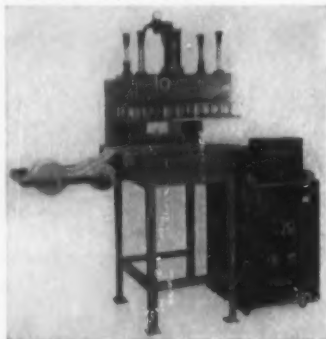
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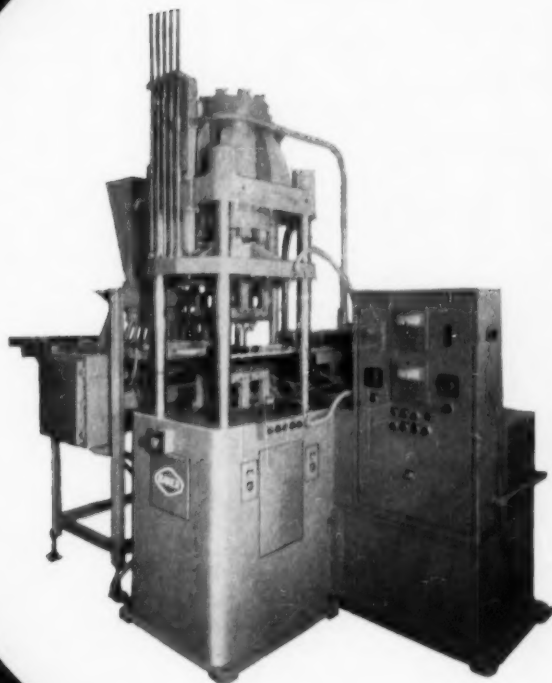
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## Vinyl Chloride

(From pp. 92-95)

tic. It was the largest for vinyl in recent years. The percentage increases have been at a rate of 5, 6, and 11% for 1952, 1953, and 1954 respectively.

**Reasons for Increase**—Why was the increase so great in 1955? One reason is that almost every manufactured product in the United States broke a record in 1955. Vinyl did better than most of them because of its usefulness in so many different applications. The greatest increases were in exports, wire coating, floor coverings, and automotive uses.

The export market is almost certain to decline severely in the near future. Many people expect that the 40 to 50 million-lb. volume reached in 1955 will remain a record for years to come. There are now over 20 plants in foreign countries and they will eventually take over their own markets. The five largest customers for American resin were the United Kingdom, Canada, Brazil, Mexico, and West Germany, all of which have resin plants of their own. A good portion of the American export went to foreign subsidiaries of American companies which, because of temporary shut-downs or lack of capacity, were unable to supply their customers. That situation will probably change as soon as those subsidiaries are ready to operate at their planned capacity and the foreign-owned plants add their proposed new facilities.

**Automotive Use**—Use of vinyl in automobiles received a big impetus in 1955 not only because of a record-breaking 8 million passenger car year, but because the number of yards of vinyl-coated upholstery used per car was on the increase. The estimate is now about 15 sq. yd. per car. In addition to upholstery, there is wire coating, welting, door lock buttons, distributor cap nipples, crash pads, rear windows, and various other items.

The total amount of vinyl resin per car is probably 4 or 5 pounds.

As much as 200 ft. of wire is used per car and it is 90% vinyl coated. Ignition and starter wire is about all that is left with rubber coating. An automobile uses 60 or more lb. of rubber in addition to tires. Vinyl

processors have set their goal on acquiring at least half that volume. Fan belts, spring cushioning, and the radiator hose seem beyond their reach. Upholstery cushioning with vinyl foam may be only a distant possibility. But unplasticized vinyl sheeting may some day work in for door linings, top linings, and other parts. Injection molded window gaskets, wind shield wiper gaskets, and many other parts could supersede rubber since injection molding is so much faster than compression molding of rubber.

If the total vinyl chloride use reaches 10 lb. per car in the next few years, vinyl processors will be happy. Of course, there is always a possibility that vinyl upholstery will be subject to style changes and will lose out to other materials every now and then. And whether or not the auto industry can keep its 8 million car rate in future years is a question only time can answer. But, by and large, there is a feeling that the vinyl industry can count on selling a minimum of at least 35 to 40 million lb. of resin annually for use by the automobile builders. There is a chance that this amount could be doubled in from 5 to 10 years' time if the vinyls can pick off some of the applications now in rubber, such as window channeling, small gaskets, floor mats, and the like.

Wire and cable coating (in the Molding and Extrusion classification in Table VII, p. 93) is now close to the biggest consumer of vinyl resin of any classification unless film and sheeting are taken together. Use for wire covering was probably from 80 to 85 million lb. in 1955 compared with 70 million in 1954. The big building construction program was in large part responsible for this great volume, for nearly all building wire is now jacketed with vinyl.

**Use has Doubled**—Wire coating resin volume has almost doubled in four or five years' time. That rate is not expected to continue, but there should be more growth before the leveling-off process begins. In addition to the automotive and construction fields, vinyl-coated wire has begun to move into some phases of the communications field. It is not used for power-line insulation because heat resistance and electrical properties are not good enough. But

there is a vinyl-jacketed submarine cable in the Oakland, Calif., harbor that has been in service for 10 years. Vinyl-coated signal cables for rail-ways are now in use. A southern rural telephone cable with color-coded wires has been installed to help cut repair bills.

Competent authorities think the ceiling for wire coating resins may be something like 120 or 130 million lb., to be reached about 1960 or shortly thereafter. Much depends upon certain circumstances. First, the construction industry would have to keep up its present pace, but many economists doubt that it will. Second, there is potential competition from several sources. Polyethylene may eventually overlap vinyl for wire coating in some applications and take perhaps 10% of its market. Neoprene is already competing in some markets and may take more. Price will be the deciding factor in many instances, but no one can be sure of the relative price of the two materials five years from now. Both are coming down. Butyl rubber is coming strongly into the market because of its superb electrical and aging properties but may be confined primarily to the power lines which don't use present vinyl resins.

A great quantity of electrical-grade vinyl resin was also shipped overseas in 1955, where it finds great acceptance because of quality.

**Floor Coverings**—Everybody expected vinyl chloride floor covering resins to show unusual growth in 1955, but nobody expected to see an over 55% increase as shown in Table VII, p. 93. Vinyl-type floor coverings have been making headway since 1953, but even the most enthusiastic booster hardly expected resin consumption for this product to jump from 25 to 55 million lb. in two years.

Vinyl-asbestos tile, which uses only an average of 14% vinyl, was the biggest consumer of resin among the various types of vinyl floor coverings. It competes primarily with asphalt tile. There are no accurate estimates available for comparison in 1955, but in 1954 there were 750 million sq. ft. of asphalt tile and 125 million sq. ft. of vinyl asbestos. The latter is eating into the 550 million sq. ft. of C and D grade or lighter-colored asphalt (included in the above 750 million sq. ft.) which, in-

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cidentally, is not asphalt but primarily coumarone indene and petroleum resins which are also plastics.

Vinyl-asbestos tile requires a soft, copolymer-type resin that is similar to but not quite the same as the 35¢ resin used for phonograph records and can linings.

Laminated and fully resilient vinyl floor coverings use a hard vinyl resin. Several incidents aroused attention in these types during the year. One producer made a decided increase in the thickness of the vinyl used on a felt base laminate. The complete laminate is 80 mils thick. Several other producers of resilient tile added 80-gage material to their 125-gage line. These new lines are supposed to have added a considerable amount of volume to total sales, but rubber resilient tile still is under the vinyl price. In fact, it was the rubber tile producers who started the thin-gage division.

Another type of vinyl floor covering is the printed design paper type which is covered with a clear vinyl overlay and laminated to felt. Supposedly, the vinyl used for this type of flooring is reported in the classification of "Paper Treatment" in Table VII, p. 93.

**Flooring Growth Factors**—The tremendous growth in flooring grew out of several factors. As usual, the building program was probably the greatest. More firms getting into the business was another. Customers have learned to appreciate the superior qualities and economy of maintenance that goes with vinyl flooring. But perhaps the most dynamic factor was a leading producer of floor coverings who had been only dawdling with vinyl before 1955. Last year he finally got the type of product he wanted and put on a campaign to sell vinyl floor covering, including price reduction, that did the business.

How far this vinyl floor covering market can go is a big question. A year ago the ceiling was thought to be 70 or 80 million lb. of resin, to be reached in the late 1950's. After the 1955 performance, all predictions are off. A guess might be a 100 million-lb. ceiling—with the privilege of changing that guess overnight.

**Growth Areas**—This area of consumption for vinyl resins—exports, automotive, wire and cable covering, and floor coverings—may be

the key to determination of how fast and how far vinyl chloride use can continue. Together, they account for somewhere between 210 and 220 million lb. of resin or in the neighborhood of 40% of all domestic resin sold in 1955. Will they continue to grow or have they reached a leveling-off point?

Exports are not expected to grow; they will probably decline.

Automotive uses should grow. Assume it increases to 9 or 10 lb. per car by 1960. At the present rate of auto production or a little more, that would be 80 million lb. in 1960. The important questions are: how much will auto production increase and how much will the average per-car use of vinyl increase?

If wire coating resins increase by 10 million lb. a year for the next five years, they will exceed expectations. If they do, it will mean between 120 and 130 million lb. by the end of 1960 with a substantial allowance for the wire used in autos.

If floor covering resins double their use by 1960, everybody will be happily surprised. And that would put the figure at about 100 million pounds.

**In 1960?**—The total of these four items in 1960 would then be approximately 330 million pounds. If these uses still remain 40% of the total, the vinyl chloride industry could count on about an 825 million-lb. over-all production figure. That's not much over present and planned capacity increases. Furthermore, it depends on a continuation of the present high export rate and an over-all industrial production rate in the entire national economy that will equal or exceed the record breaking year of 1955. It's wonderful to think of an industry with a sales volume of 825 million lb. in 1960, but that's a tremendous goal to attain from a 500 million-lb. peak in 1955. It would mean a 10 to 15% growth each year and a poundage increase of from 50 to 100 million lb. a year.

Few realists are that optimistic—they would be surprised to see an industry which required five years to grow from 300 million in 1950 to 500 million in 1955, increase by the same percentage in the next five years. The vinyl industry may continue to remain the biggest volume resin in plastics, but its growth is



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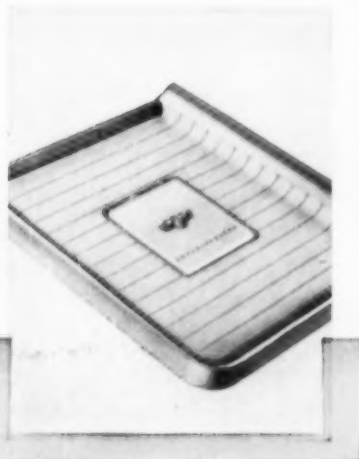
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almost certain to assume a gradual curve rather than the present sharp upward slope. Furthermore, it may be soon expected to reach a period when its sales graph will have bumps and slumps just like older commodities.

These factors are emphasized to point out that 1955 would be a dangerous year to use as a measuring stick for gaging the future growth of vinyl chloride. It will grow healthily but is unlikely again to go through a year when so many things got so big all at once.

One of the tempting baits that is always attracting prospective new producers to the vinyl chloride field is the future possibility for developmental products. Two that have been in the spotlight for several years are rigid (unplasticized) and foamed vinyls.

**Unplasticized Vinyls**—Rigid or unplasticized vinyls are not new. There are many varieties. Some of them were among the first vinyls to be produced. The resin for phonograph records, can coatings, and asbestos floor tile is unplasticized. But, generally speaking, the trade interprets "rigid" vinyls to mean vinyl resin for sheeting or pipe that requires little or no plasticizer.

The first of these materials to gain prominence in this country was Bakelite's copolymer vinyl chloride-acetate formulation. There are several types. Each one is a combination of various standard copolymer resins. They are calendered and press polished or "planished." Chief uses in the past have been for Army and commercial relief maps, templates, flexible book bindings, signs, instruments such as slide rules, and in the graphic arts for calendars, displays, and the like. Sales were never over a few million lb. a year until the sheets proved their excellence in ceiling light reflectors.

In recent years, several producers have developed straight P.V.C. resins that can be used for sheet and pipe without a plasticizer. Some of them are the same resins used for elastomeric purposes with a slight alteration which makes them easier to work. B. F. Goodrich Chemical Co. has gone a step beyond this and created a modified P.V.C. by adding an undisclosed ingredient which gives greater impact strength than when the resin is used alone. The two types are differentiated by clas-

sifying the modified material as "high impact," the straight P.V.C. resin is classified as "normal impact." It has greater chemical resistance than either the modified P.V.C. or the unplasticized vinyl copolymer resin. Some extruders say the straight P.V.C. unplasticized resin has great enough impact strength for almost any need. There are those who think that volume of the straight P.V.C. resin will far exceed that of any other unplasticized vinyl for sheet and possibly even for pipe.

Volume sale for all unplasticized vinyl sheet, including the copolymer type, was thought to be somewhere in the 8 to 10 million-lb. range in 1955. Most of it was copolymer—only 2 or 3 million was straight or modified P.V.C. The chief uses for the straight P.V.C. unplasticized sheets were glazing, duct work, and vacuum formed signs, displays, and letters. There were one or two P.V.C. packages, but packaging use in volume is still to come.

Most optimistic estimates for the rigid or unplasticized sheet market are 50 million lb. annually and even that is far in the future—10 years at least.

**Stamped P.V.C. Sheet**—One producer is convinced that rigid P.V.C. sheet can be stamped like metal, with a slightly altered stamping press, but the metal workers have not yet taken it in. They haven't developed a market. There is lots of talk about future possibilities in truck lining, partitions, siding, etc., in this field, but they all seem a long way off. Vinyl is still a thermoplastic and does have limitations.

**P.V.C. Pipe**—Unplasticized vinyl pipe has been a dream of the vinyl industry for many years. It was once looked upon as a super-super-super market that would eventually transcend all other vinyl markets. Minds have changed: pipe is now thought of as simply a "good" market that may come into its own some time late in the 1950's or in the early 1960's.

Consumption of vinyl resin for pipe grew from less than 1 million lb. in 1954 to 2½ or 3 million lb. in 1955. If it doubles in 1956, nearly everyone concerned will be surprised. There were some unfortunate experiences in the early history of P.V.C. pipe; extruders had trouble in learning how to handle it; fit-

tings were unavailable when needed; and customers bought only enough for testing . . . and conclusive tests take an unbelievably long number of years.

Most of these troubles, except the testing, have been successfully overcome. There are now several molders of unplasticized vinyl fittings. A number of large metal pipe producers have gone into the business. The market in chemical plants alone, where vinyl is particularly practical, could be in the millions of pounds. The oil fields are another possibility. Large diameter pipe (over 6 in.) has been extruded in Europe, but even with vinyl prices on the decline it is hard to conceive of many applications, except possibly chemical, where the user could afford large diameter vinyl pipe.

Normal - impact unplasticized vinyl is believed to be moving ahead of high-impact resin for pipe. In the first place, its chemical resistance is most desirable. Secondly, it has higher tensile strength and will withstand greater working pressure. One new vinyl pipe producer (a metal pipe manufacturer) is selling ½-in. vinyl pipe to withstand operating pressures up to 575 lb. at 75° F. High-impact strength, gained by using modified vinyl, is most needed when handling and putting pipe together, but it seems that one can't have the properties of both types at one time. In Germany, where vinyl pipe first received notice and where 9 million lb. are produced each year, workmen have been taught to handle it gently, almost like glass. In the United States, a worker is just as likely as not to whack it with a wrench or give it other rough treatment. Incidentally, the Germans seldom use pipe fittings; they generally weld lengths of pipe together.

Some extreme claims have been made about the future potential for vinyl pipe. But real big volume seems to be in the distant future. A 50 or 60 million-lb. figure in the early 1960's would be most welcome if achievable. There are so many problems to overcome, aside from quality of the pipe, that rapid adoption can't be anticipated. One or two successful and extra large installations could change the outlook, but those who are talking about the great future for rigid vinyl pipe

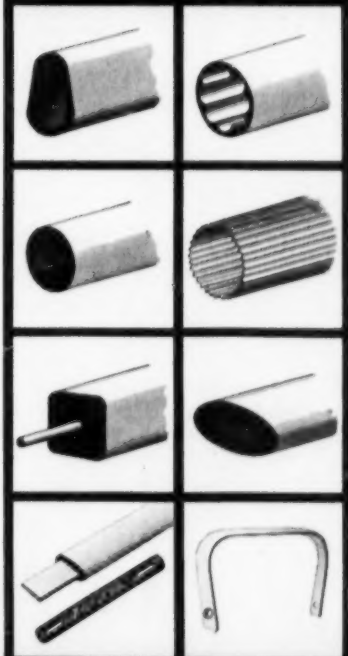


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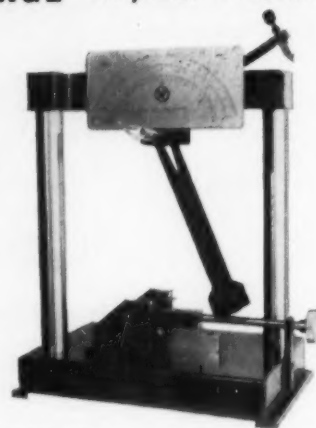
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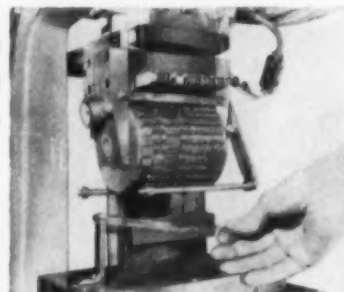
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**Foam Possibilities**—Great hopes have been built up for vinyl foam. An operating rate of some 3 million lb. of resin a year was reached late in 1955. The estimate for 1960 is 25 million lb. of foam which would require about half resin and half plasticizer.

There are two types of foam—chemical and mechanically blown. The former can be blown in a mold and is generally a closed cell or sponge type, but it can also be blown without pressure to obtain open cell foam. Mechanically blown or the Elastomer type is generally open cell. Its commercial form is most often in sheet form, but it can also be molded. It is less costly than chemically blown foam and lends itself more readily to continuous production.

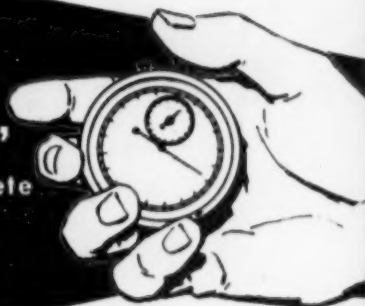
The mechanical foam can be formed in densities of 4 to 10 or 12 cu. ft. per pound. The load carrying capacity can be varied independently of its density and the processor can make it in different degrees of hardness or softness to meet his customers' demands at little change in cost. Rubber foam goes up in cost as the density increases.

Large quantities of vinyl foam were used in 1955 for automotive crash pads and sun visors. Other uses are in automobile arm rests, subway car upholstery, some types of furniture upholstery, rug underlay, cushions, slippers, and bath mats. A growing use is for handbags and novelties produced by a method in which the foam is heat sealed between a surface layer of thin vinyl film and a backing of heavy vinyl sheeting to give a three-dimensional or quilted effect.

Vinyl foam is not yet recommended for automotive upholstery because of the possibility of compression set that may result at the high temperatures sometimes encountered when an automobile is left in the hot sun for several hours. But chemists say that problem will soon be overcome. In fact, an improved heat-resistant material is expected to be announced early in 1956. The mattress and mattress pad field is still an uncertain possibility for vinyl foam.

The future for vinyl foam is promising but unsettled. Competing with rubber latex foam in the upholstery

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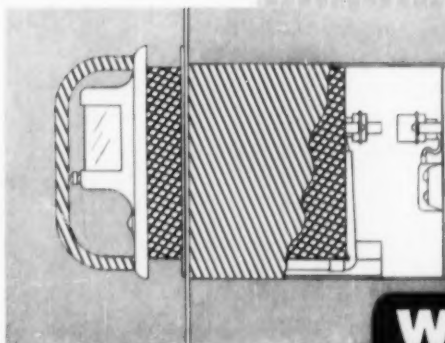


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field is like a small but good college football team trying to play the monstrous Cleveland Browns. But even if this competition can't be met at once, there are many other possible uses to explore.

Urethane foam is the other competitor. Both urethane and vinyl foam are so comparatively new in this country that it is difficult to determine whether or not either will obtain a major share of the foam market. They are competitive in nearly all applications. Price will no doubt determine the result.

A comment on price from a distributor of both vinyl and urethane foam is: "Urethane foam on a per pound basis is now more expensive than vinyl foam, but urethane foam is commercially available in lower-density materials which, on a cu. ft. basis, are less expensive. Consequently, many customers are using the low-density urethane simply because of cost."

Some of the advantages claimed by vinyl foam over other foams are: it can be heat sealed; it is relatively odorless; there is less scrap left over after processing; and it is non-flammable. A hackneyed phrase that is probably quite accurate at the moment is that each of the three foams will find its own markets—there is room for all. But, certainly, vinyl foam's future has improved considerably since two years ago when those most interested seemed downhearted by the widely publicized urethane developments.

**Plastisols**—Mechanically foamed vinyl is derived from vinyl plastisol resin. Plastisols are another of those vinyls upon which great faith has been built for the future. The largest volume producer, B. F. Goodrich Chemical Co., has added capacity to their present facilities for producing them. The company is reluctant to state present volume, but estimators in the trade believe that total consumption of all plastisols, organosols, and plastigels in 1955 was between 45 and 55 million pounds. It has been a steadily growing business over the years. The spread coating industry consumed about 20 million lb. in 1955, about 8 million lb. were used for toys and dolls, and the balance was consumed by coating and sundry items.

**Specific Statistics**—The vinyl chloride statistical situation, as put forth in Table VII, p. 93, is all clut-

tered up because of the previously mentioned foreign business done in 1955. Some 70 or 75 million lb. are involved—45 in exports and 20 to 25 in imports.

The various firms who report to the Tariff Commission do not report exports in a lump sum. They are divided up according to classifications shown in the table on a ratio or percentage basis to correspond with American usage. Unfortunately, that method is not very accurate. By such a method, export resin would include great quantities of calendering resin, which is not the case. By far the greatest portion of export resin is actually of extrusion or miscellaneous grade. Table VII is weighted to that effect.

Import resins are not included anywhere in Table VII. They are thought to have been divided about 10 million for film, 8 for sheet, 6 or 7 for extrusion, and the balance in various classifications. The estimated 18 million lb. of imported resin used for film and sheet is probably far more than was credited to exported resin in this classification, so it is likely that the amount of resin handled by calenderers in the United States was several million lb. over the sum given in Table VII for film and sheeting. In the extrusion classification, the balancing of exports and imports would probably show that 20 or 25 million lb. of the 178 million-lb. total ended up in the hands of foreign extruders.

Vinyl film shot upward in 1955 after several years of decline. It is thought that somewhere between 70 and 75 million lb. of film was actually calendered in the United States in 1955. An accurate estimate is impossible because there is an overlapping with sheeting since some report film up to 8 mils and others up to 10 mils thick. Then, too, there is the mix-up entailed by the import-export situation. And, in addition, the figure includes some 5 or 6 million lb. of resin used for extruded and cast film. The latter in particular is growing nicely for use in tape and storm windows.

Table VIII, p. 94, shows what has been going on in film. One of the interesting features in this table is that it is a testament to the utilitarian qualities of vinyl resins. Back around 1950 or 1951 the volume of compound for drapes was around 40 million pounds. Today it

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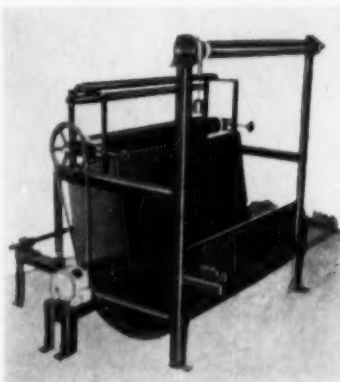
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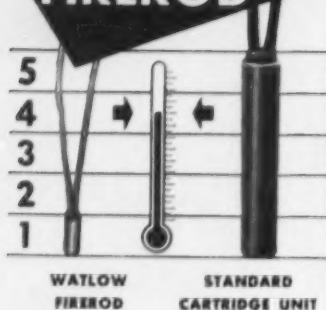
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is 17 or less, yet the total volume of film sold is just as great as ever. When vinyl loses out in one field, it picks up in another.

**Thicker Film**—Another healthy development in the film field has been the increasing tendency to use thicker film for shower curtains and raincoats.

The sheeting figure, including rigid sheet, given in Table VII, p. 93, is also deceiving because of complicated statistics and changes in applications. But it is true that sheeting has suffered a bit in the upholstery field from competition by vinyl-coated fabric.

When both film and sheeting are added together for a total of 128 million lb. of American resin consumed by the trade, the situation is more understandable. For example, the clear vinyl auto seat covers that were so prominent in the market in 1955 are furnished in thicknesses varying from 6 to 16 mils—they overlapped in both film and sheeting statistics. Inflatables are another example—prior to 1955, they were from 8 to 12 mils thick, but now a great portion of the market is in two thin films laminated together. Back yard wading pools have been particularly affected by this trend. The laminates are all over the place and have added considerable poundage to both film and sheeting volume. Film laminated to printed fabric, unwoven fabric, and knit goods gives promise of adding considerable impetus to the upholstery and other vinyl markets. Laminators in this field have been operating seven days a week around the clock for months. Vinyl sheeting is also included in the laminate field (see Table IX, p. 95) and there are those who think it has a great future when laminated to metal.

**Formed Sheet**—Vacuum forming of vinyl film or sheet is also now well established. One good authority estimates that 13 or 14 million lb. of vinyl is handled annually by this process. Leather fabricators are using it in great quantity for handbags, brief cases, wallets, and novelties. Other uses are for bath mats and place mats. One fabricator is reportedly using as much as 150,000 yd. for face masks. The automotive industry is showing great interest in the possibilities of vacuum formed vinyl sheet for inner door panels. They like the deep embossed effect

that can be obtained. They are trying it on a sponge or fibrous glass core as the surfacing material for crash pads.

**Fabric Coating**—The big increase in fabric coating received its greatest impetus from the automotive industry in 1955, but there were many other contributing factors. It was a foregone conclusion years ago that supported vinyl would eventually take over a large part of the upholstery market since the material is stronger and can be sewed without tearing. Better and more efficient backing materials, such as knitted fabric and unwoven fabrics, have improved the situation. A new unwoven nylon backing is exceptionally strong and permits much better embossing effects.

Calender coating is thought to account for around 32 million lb. of the 55 million-lb. total used for fabric coating. The balance is mostly spread coating with a small amount of vinyl latex used for primer treatment on fabric before the vinyl coating is applied. Spread-coated material has also become popular for high quality wall coverings and in various applications where a real thick layer of vinyl is advantageous.

The ubiquitous vinyl laminate may make some difference in this field in a few years time. A clear sheet of film laminated over a printed fabric offers a multitude of designs and patterns not obtainable by conventional embossing methods.

The extrusion and molding classification in Table VII has been partially covered in various parts of this article. A guess at the proportions would be as follows:

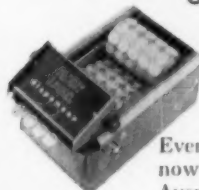
Wire coating	80,000,000 lb.
Phonograph records	25,000,000 lb.
Profile (belts, gasketing, etc.)	20,000,000 lb.
Slush and elastomeric molding, dip coating, etc.	25,000,000 lb.
Garden hose	15,000,000 lb.
Miscellaneous	13,000,000 lb.
<b>TOTAL</b>	<b>178,000,000 lb.</b>

**Other Vinyls**—Only vinyl chlorides have been considered in this report. The other vinyls, including saran, vinyl acetate, polyvinyl butyral, polyvinyl alcohol, and carbazole have become too big and complex to dismiss in a single paragraph as in past industry reviews. Progress in these materials will be reported at a later date.—END

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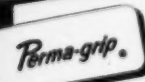
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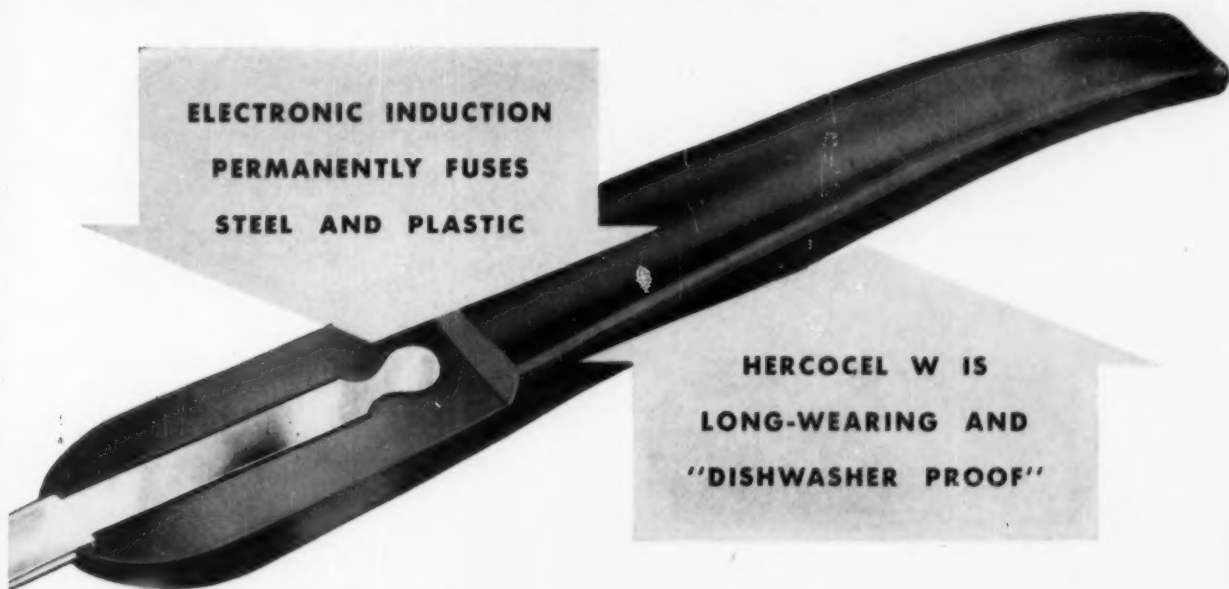
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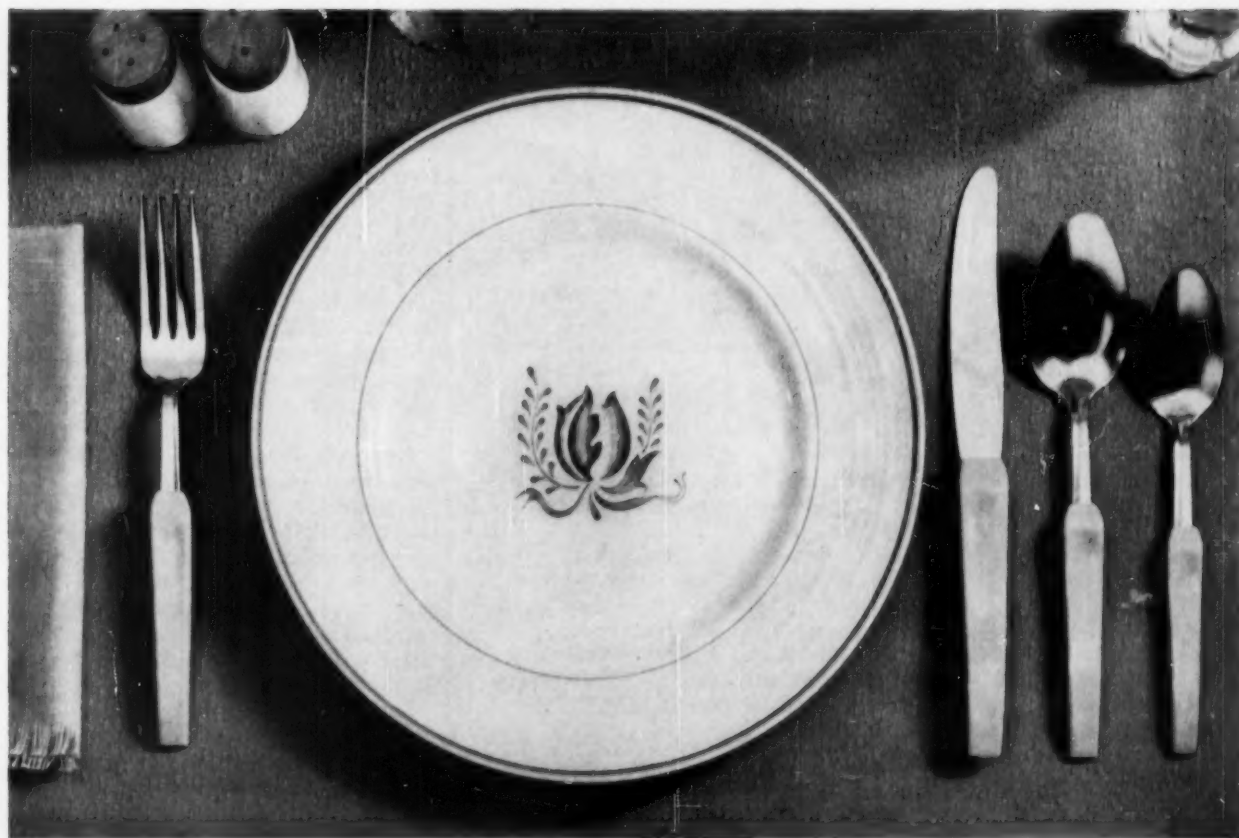
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## Polyethylene

(From pp. 95-96)

to be over 40 million lb. for the year. Another is that some of the new producers came in with a fairly large production during the first month or two, which is greater than the amount they can sell immediately.

Then again this difference between production and sales may emphasize the situation in film, electrical grade, and blow molding resins. Processors are fussy about the quality they use for these purposes and it is a well-known fact that these resins are more difficult to produce. Since film-grade resin is the largest market for polyethylene and since new producers would naturally have more trouble in developing it, the difference between sales and production volume may be explained by the possibility that the new producers have not yet moved into the film- or electrical-grade resin field in appreciable volume. Most of their production is for pipe and molding applications where the market is more crowded.

**High-Pressure Production**—There are now eight companies in the United States producing high-pressure polyethylene resin. Their total capacity is estimated to be in the neighborhood of 530 million lb., when allowance is made for the probability that each can produce more than their announced capacity. Another new plant belonging to Carbide and Carbon will start operations in 1956 with an announced 60 million-lb. capacity. Most of the new producers who came in before June state that they are well satisfied with results and are selling as much as they can produce. Those who came in after June are more conservative in their statements.

**Improved Properties**—Ordinarily the advent of six new producers into one field of plastics in one year would be highly exciting news. But there was an unprecedented blast of excitement in early 1955 when an announcement was made that a new polyethylene with some remarkably improved properties would soon be available.

**Low Pressure Announced**—The enthusiasm started when Koppers and Phillips Chemical Co., a division of Phillips Petroleum, announced almost simultaneously that

they had samples available and would soon start construction on plants to produce so-called low-pressure polyethylene. The polymerization process for making conventional polyethylene requires from 15,000 to 30,000 p.s.i. and higher. The new polyethylene process requires 500 p.s.i. or less. Hence the distinction.

Koppers announced that it had received a license to produce the low-pressure material from the German scientist, Prof. Dr. Karl Ziegler of Max Planck Institute. Phillips announced that they had developed their own process for making the new polyethylene and would not only make their own but would license a few companies which might be interested.

**Catalysts the Key**—The new polyethylenes employ a new concept in polymerization and new catalysts that have never before been used for plastics. Perhaps even more significant than the fact that they can be used to polymerize ethylene without pressure is the discovery

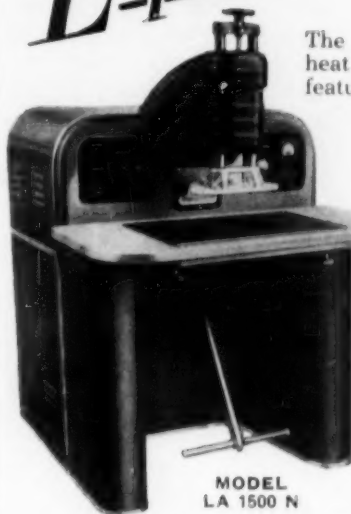
**Table XI—Estimated  
Polyethylene Sales Since 1948**

Year	lb.
1948	15,000,000
1949	31,000,000
1950	48,000,000
1951	80,000,000
1952	95,000,000
1953	137,000,000
1954	207,000,000
1955	350,000,000

that these catalysts can be used to polymerize many other materials—particularly the olefins—and thus introduce new lines of plastics not now in existence. One report says that an Italian company is working on polymerization of styrene by this method with the goal of producing a polystyrene that will withstand 380° F.

The outstanding properties of the new polyethylenes are much greater stiffness and a heat distortion point of from 240 to 260° F. First reports of the new materials were that they would be less costly because initial plant outlay would be much less than that necessary in high-pressure

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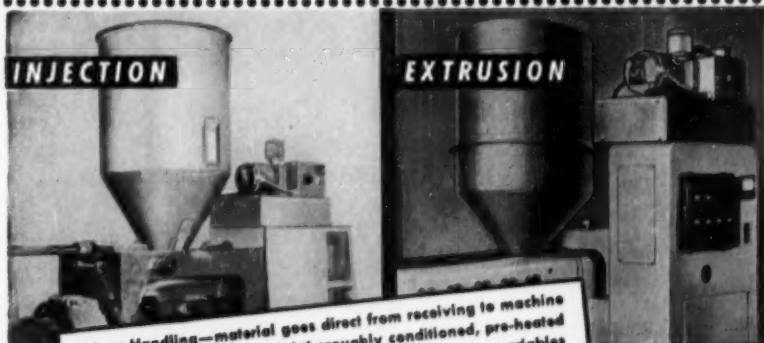
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plants. However, the new producers have made no claims of lower cost. Chemical engineers maintain that the cost of removing catalysts and unpolymerized portions toward the end of processing will be expensive. There is no assurance that the new polyethylenes will ever be less costly than standard polyethylene.

**Price Reductions**—The latter has been reduced steadily in price since its introduction and a former president of Bakelite once stated that a price in the 20¢ range is a future possibility. After a high-pressure plant has been amortized, the cost of production is relatively low—said to be as little as 8 to 10¢ a pound.

Following the Koppers and Phillips announcements, a long list of companies announced that they had received licenses from either Ziegler or Phillips, or both, to produce low-pressure polyethylene. Every company now producing polyethylene, except two, was included and those two are known to be working on development of a low-pressure material. In addition, there are four other companies not now in polyethylene, who have taken out licenses. Various foreign companies, especially in Germany, are also working on development of a low-pressure polyethylene under license from either Ziegler or Phillips.

**Sample Quantities Only**—One of the unusual circumstances surrounding the announcement of this new glamor boy of the plastics industry is that such a commotion could be raised about a material that is available only in sample quantities. To date, nothing more than good-sized pilot plants are producing low-pressure polyethylene in the United States. One plant in Germany is operating at an annual rate of 7 or 8 million pounds.

There is yet no proof that the gap between pilot plant and commercial production can be quickly bridged. Polyethylene is a tricky material to produce—even the older producers still have trouble with uniformity. The path to production of the same grade material in a commercial plant that is produced in a pilot plant is extremely rough and rocky.

If history is repeated, it is quite unlikely that any great amount of low-pressure polyethylene will be available in 1956. Furthermore, nearly all the pilot plant material has been molding-grade resin.

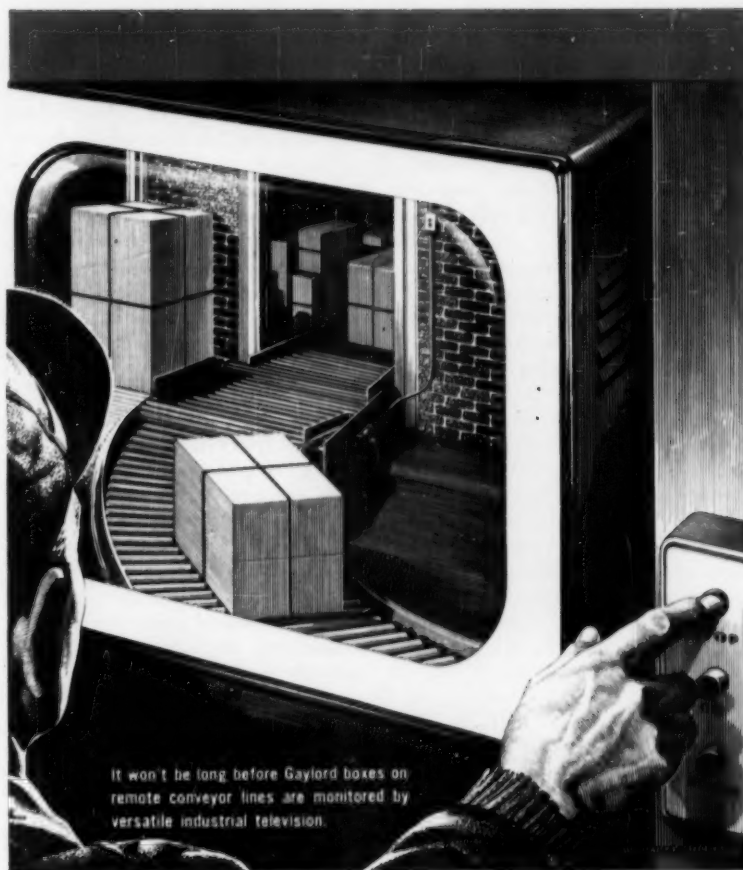
Whether or not it will have satisfactory properties for film, electrical insulation, and coatings is yet to be proved. The bottle producers are enthusiastic about it because of its stiffness and heat resistance, but it is probably too stiff for squeeze bottles and containers with a lap-seal.

Nevertheless, prospective producers of the new polyethylenes have great hope in their ability to overcome all foreseeable problems. Plans are going ahead rapidly to build new plants. Some are even scheduled to start production in 1956.

**One Billion-Lb. Capacity**—The advent of low-pressure polyethylene brought with it the addition of five new companies which, plus the eight already in production on high-pressure polyethylene, totals up to the 13 previously mentioned. There is already an indication that several of them may not go through with their projected plans, but there are also several other firms still tinkering with the idea of building a polyethylene plant. If the 13 mentioned above all expand or build according to presently indicated intentions, the total capacity will be close to 1 billion pounds. That capacity should all be available before 1959.

If this huge capacity is available at that time, there will probably be a few sales managers in a sweat. Polyethylene has had a remarkable growth—up to now the market has absorbed new capacity almost as fast as it came in. But jumping from 335 million lb. in 1955 to an 850 million-lb. sales volume by 1960 is something to worry about. And even then the sales figure estimate is well under the production capacity estimate. The sales estimate for 1960 given in Table X, p. 96, was made by one of the most optimistic producers, but even he couldn't foresee a billion-lb. sales volume by that time. An increase of over 100 million lb. a year would be needed to reach even an 800 million-lb. sales figure.

Yet polyethylene has had such a remarkable record that the seemingly impossible may be attainable. If the new polyethylene lives up to its promise, it will broaden the base considerably. Most producers now believe that it will overlap present polyethylene applications by only a small percentage, that it will be used mostly for products which can't be produced from high-pressure poly-



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ethylene. If this theory proves true, polyethylene sales may continue to zoom upward for several years at the same rate as in 1954 and 1955, or even faster. On the other hand, a cautious person may wonder just how long any material can continue to grow at a rate of 125 million lb. or more a year.

However, there are still many gimmicks in the kit that can be used to increase sales volume. One is price, as mentioned before. A lower price level might improve sales in every category listed in Table X—especially bottles and film.

**Film Volume**—Polyethylene film sales volume has surprised everyone—each year it goes beyond previous estimates. The use of this film as a laminate with other materials has scarcely started. Treating the film with chemicals or other resins to give it better clarity and a better surface for printing or heat sealing could increase its usefulness many fold. And according to the director of sales for Grand Union Co., a food store chain, the packaging opportunities in food stores have been only 50% realized. If that is true and

considering polyethylene's part in food packaging, what are the ultimate possibilities? Yet only between 60 and 65% of polyethylene film is used for packaging. Other fields, such as construction, agricultural, and miscellaneous, are growing faster and faster—may even take a larger percentage of the whole than packaging in a few years' time. The estimate of 300 million lb. of film by 1960 looks big, but it could be the most conservative estimate on the list.

The bottle estimate looks over-optimistic, too. Present polyethylene bottle molders think it is beyond reason. But the new polyethylene could be one reason for the high estimate—rigid, boilable bottles could become a big item. Returnable bottles for soft drinks are a possibility. Collapsible tubes, included in this classification, seem destined for widespread use. And if the new coatings or linings now being tried actually prevent permeation of oils, alcohol, etc., as it is thought they will, the bottle volume could go to tremendous heights. Lower cost of polyethylene might also make more

volume increase in this classification than in any other.

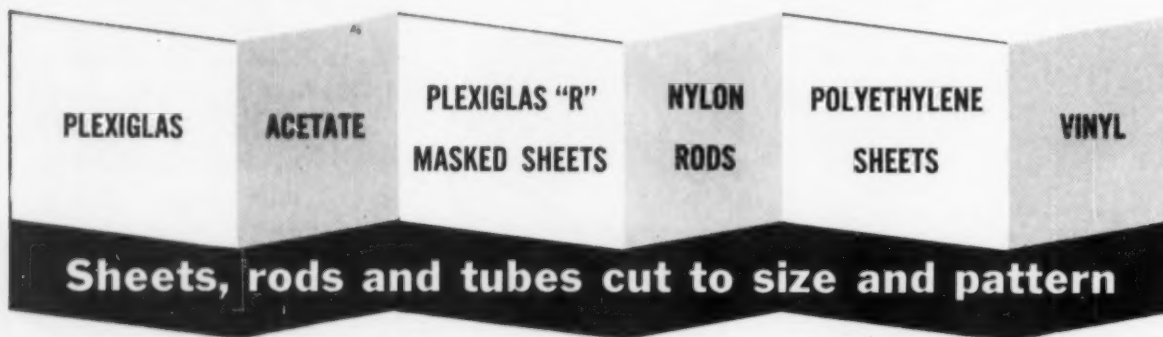
All the other classifications in Table X, p. 96, are subject to this speculation. In most cases, they are at the beginning of their growth curve. No one has yet suggested placing a ceiling at a point where they may start to level off.

And still another growth factor is the continual improvement in the high-pressure resins that makes them more suitable for various application. The two oldest and largest producers now have 16 or 17 different formulations, each tailored to do a specific job. The all-purpose resin has disappeared from view. If proof of progress is necessary, all that is needed is for the doubter to compare a good 1955 film with a good film made in 1950 or 1951 and note the difference. They look like different materials. The same comparison could be made in coating, molding, or other type resins.

In terms of the race track, a horse named Polyethylene has just started to run—wait until he rounds that last turn and starts coming down the stretch!—END

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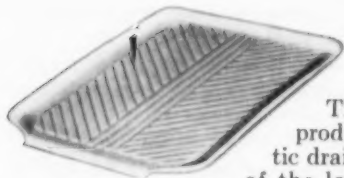
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## Nylon

(From page 96)

gerous business. Several analysts have stated that nylon will never reach large-volume use until it is reduced to \$1.00 a pound.

The leading producer in the United States says that nylon is basically so costly to produce that no revolutionary price drop can be expected. Europeans are inclined to hint that a much lower price is easily within the bounds of reason before too many years have passed. But a new American producer who entered the field in 1955 with a European type resin has made no attempt to alter the nylon price structure now current in the United States. Several years will probably elapse before there will be an accurate indication of whether or not nylon is to become a considerably lower priced plastic than it is today.

The entry of Allied Chemical & Dye Corp.'s Barrett Div. into the plastic nylon field and the activity of various European companies in setting up distribution agencies to sell their material in this country last year stirred up more interest in nylon than any year since Du Pont started its campaign to educate molders on nylon's possibilities.

**Difference in Types**—The one point that needs emphasis is that the Barrett and European resins, or nylon-6, are somewhat different from Du Pont nylon-66. The European-type resins, except the French Rilsan, are technically caprolactam. Many claims are made concerning the differences between them and nylon-66. There was not enough used in 1955 to indicate whether caprolactam will actively compete for the same applications as nylon-66 or will move into other related fields and thus broaden the entire base for nylon. There is some indication that the latter is the goal of the caprolactam producers. The material is being suggested for items where a softer material than nylon-66 is needed, and it is also being aimed at the film and sheeting field. Nylon film as a protective film or laminate with other materials is a possibility. Vacuum formers who have been privileged to take a look at it are impressed with its performance for that type of fabrication. A full year's trial with plenty of material avail-

able is needed before the industry can be well informed on just how this comparatively new material is going to fit into the market.

Insofar as molders of nylon-66 are concerned, there has been a noticeable trend toward proprietary molding. Even before 1955 some of the largest users of nylon were captive plants or at least those companies producing special parts for one industry such as automotive. But recently there has been a tendency for nylon custom molders to include proprietary items in their lines. In such cases, the molder can keep his machines busy on his own items when not filled up with custom jobs.

**Specific Uses**—Nylon products that have been included in this development are such items as parts of window shade rollers, rollers for windows and other window equipment, curtain rods, poles and fixtures where sliding parts are essential, venetian blind parts, pulleys, nuts, screws, and kindred items. The nylon industry has apparently progressed to a point where these items can be made in standard sizes and stocked to meet the demands for small-quantity delivery.

Then, too, there are several other directions in which molders are moving. One is to redesign old jobs that were unsatisfactory—a newly designed shower head is one example. Another direction is in production of tube fittings, especially in those places where electrolytic corrosion is rough on brass or other metal fittings. Yet another is an intensified effort to scrutinize every application where moving parts are employed—gun parts, type setting machines, business machines, and other places where better abrasion resistance and improved wearability is needed. Almost anything that must be made to slide in a groove or channel or against another surface seems to be a candidate for examination as a nylon possibility.

Nylon fabric came along years ago to completely upset the silk stocking industry and then move on into the textile industry with reverberations that are still echoing up and down the length of that ancient industry's hallway. It isn't likely that nylon plastic is going to create anywhere near such a sensation in plastics, but it has been a profitable item for those molders who have had the foresight to see its possibilities.—END

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## In Construction

(From pp. 98-99)

openness in outside walls to permit maximum daylight to enter and to provide a feeling of spaciousness, large panels fabricated of translucent reinforced plastics or of acrylic (and, more recently, translucent rigid vinyl; *MPL*, Aug. '55, p. 202) came into top consideration as glazing materials for many of 1955's residential and commercial buildings. Potential markets for this type of glazing were further boosted in 1955 by the introduction of a new type of acrylic window panel formed and painted to provide "light control" louvers (*MPL*, Dec. '55, p. 94).

**Doors and Partitions**—Plastics, teamed up with conventional materials (particularly wood and metal), brought new concepts of design to the construction of doors for the modern home. One lightweight, flush door introduced in 1955 consists of a colorful, tough vinyl skin laminated to the metal face of a honeycomb core sandwich panel (*MPL*, Nov. '55, p. 98).

Accordion folding doors also developed into a prime market for plastics in 1955. In one version of such a door, extruded vinyl strips are used to hinge wooden panels together (*MPL*, June '55, p. 197); in other types, unsupported vinyl sheeting as well as vinyl coated fabrics are effectively combined with light wood or metal slats.

**Interior Surfacing**—As surfacing materials for walls or floors, plastics already have a solid reputation. Activities in this field in 1955, however, particularly in wall coverings, indicate that even greater markets can be opened. Striated styrene wall coverings, for example, extruded in long strips (as contrasted to square-molded styrene wall tiles) aroused considerable interest.

And in vinyl wall coverings, although all types showed an extensive growth in 1955, it was generally agreed that the surface had only been scratched (*MPL*, Oct. '55, p. 85). Developments in unsupported vinyl films and in vinyl-coated fabrics with pressure-sensitive adhesive backings designed to appeal especially to "do-it-yourselfers" took

most of the limelight. Conventional wallpapers coated with vinyl also came into their own in 1955.

**All-Plastics Houses**—As these applications indicate, the "all-plastics" house is probably closer at hand than many people realize.

In 1955, for example, two new buildings built of reinforced plastics panels assembled over a wood or metal framework were cited by architects as the perfect answers to two current architectural trends.

One of the buildings—an answer to a demand for large unobstructed spaces—is a geodesic dome-like barn consisting of triangular-shaped, translucent reinforced plastics panels fastened to a pre-cut phenolic laminated wood framework (*MPL*, Feb. '55, p. 92).

The second structure—an answer to current demands for units that can be put together quickly and economically at the site—is an Air Force radar shelter made up of rugged reinforced plastics panels that can be assembled over an aluminum framework by a crew of 14 men in only 3 hr. (*MPL*, Nov. '55, p. 202).—END

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## In Packaging

(From pp. 100-101)

vinyl to the packaging field) made its bid as a container for preserved fruits, cherries, etc.

Nor were formed packages reserved for mass-market merchandise alone. One specialized application which appeared in 1955 was a display box for silverware (MPt., Dec. '55, p. 107). Both the lid and the base of the box are made up of a "sandwich" construction in which a sheet of cardboard is inserted between two pressure-formed sheets of rigid vinyl. The two vinyl sheets are then electronically sealed together around their peripheries. While the strength and attractiveness of the contoured vinyl box indicate its suitability for packaging delicate electronic and medical instruments, photographic equipment, etc., considerably more interest was expressed in some quarters in the possibilities of flocking the vinyl sheet before forming and using the finished box for that type of quality packaging heretofore reserved al-

most exclusively for velvet-lined wooden chests.

The second fundamental packaging trend which opened new vistas for a possible extensive use of plastics materials was the increasing emphasis on aerosol packaging. It is estimated that close to 250 million aerosol units were produced in 1955, but only a tiny portion of this volume involved plastics. But, if the events of 1955 are any indication, the plastics industry has its sights aimed dead on the heart of this lush market. During the year, the first approach to the field by plastics was in the form of a vinyl plastisol-covered glass bottle. By the end of the year, however, the first all-plastics aerosol (melamine container and polyethylene and nylon parts) made its publicized debut (MPt., Dec. '55, p. 97). Now reports have it that soon to come out are a molded nylon aerosol, a molded phenolic aerosol, and according to one supplier, a specially engineered aerosol designed to take advantage of the properties of the new polyethylene materials.

In this respect, note should also be made of the many other advances

being made by polyethylene materials in the over-all packaging field. While polyethylene squeeze bottles and tubes, for example, continued their normal growth along established lines, new areas of application were opened by the announcement that linings had been developed for polyethylene squeeze bottles that overcome one of the basic limitations of the material — its permeability to essential oils.

Experimental reports issued in 1955 also indicated that the new polyethylenes might be less permeable to some types of materials than are the conventional polyethylenes. Polyethylene also cropped up in several applications in the form of contoured, resilient molded packages with molded-in supporting ribs, recesses, integral hinges, etc. for delicate medical and ophthalmic instruments and keen-edged tap and die sets (MPt., Apr. '55, p. 112). A polyethylene case for an electric shaver introduced in 1955 also attracted attention as the possible forerunner of a whole new line of large-volume commercial applications.—END



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**POLYESTER RESINS.** Technical bulletin gives properties and cure times of "Aropol 7110" for matched die work, hand lay-up and press laminating, and "Aropol 7110LS" for the manufacture of corrugated sheet. Archer-Daniels-Midland Company. (A-602)

**LAMINATED PLASTIC SHEETS.** Engineering data booklet contains information on the physical, electrical and mechanical properties of 30 grades of laminated plastic sheets produced by this company. Taylor Fiber Company. (A-603)

**FORMABLE STYRENE SHEET.** Illustrated literature describes, gives specifications and physical properties of company's rubber-modified styrene thermoplastic sheet materials. Chicago Molded Products Corporation. (A-604)

**ELECTRONIC HEAT SEALER.** Illustrated brochure describes and gives specifications for this company's Model CA 3000 electronic heat sealer. Includes sample of intricate three dimensional multi-color work produced on this machine. Cosmos Electronic Machine Corporation. (A-605)

**VACUUM FORMING EQUIPMENT.** Illustrated literature gives description and prices for "Vacu-Magic" vacuum forming machine and accessories; machine features twin forming tables, interchangeable size ovens and forming tables. Whitlock Plastic Company. (A-606)

**LAPPER FOR INJECTOR NOZZLE SEAT.** Data sheet describes hand tool designed to remove nicks from nozzle seat without removing heater from injection press. Injection Molders Supply Company. (A-607)

**MOLD STEELS CATALOG.** Illustrated 42-page manual-catalog serves as guide to the selection, application and heat treatment of Carpenter steels suitable for plastic molding. Carpenter Steel Company. (A-608)

**REPLACEMENT PLASTICIZER.** Technical bulletin provides test data and a typical-properties list for "Polycon #40" plasticizer, developed to partially replace DOP-DIOP types in products where water-white color is not required. Brown-Allen Chemicals Company, Inc. (A-609)

**CUSTOM INJECTION MOLDER.** Illustrated literature depicts facilities and services of custom injection molder, including mold-making, fabricating, decorating and finishing departments. Sinko Manufacturing & Tool Company. (A-610)

**AUTOMATIC STEAM TRAP.** Illustrated catalog describes, gives specifications for line of automatic steam traps in sizes from

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**EXTRUDING EQUIPMENT.** Illustrated catalog gives specifications for line of extruders in sizes from 1½ to 8 inches, speed ranges up to 16:1, cylinders up to 60 inches long. Also describes extensive line of auxiliary equipment and accessories. Hartig Engine and Machine Company. (A-612)

**PHENOLIC MOLDING COMPOUNDS.** Illustrated booklet describes various grades of "Durite" phenolic molding compounds. Also describes "Durite" impregnating and laminating resins and cements for bonding plastics. The Borden Company. (A-613)

**ELECTRONIC HEAT SEALER.** Bulletin presents description of 3 kw heat sealer with a working area of 18 by 24 inches. Unit features high reserve power capacity, automatic arc suppressor. Sealomatic Electronics Corporation. (A-614)

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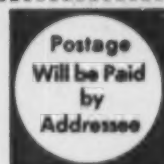
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## In Furniture

(From pp. 103-104)

pliers of rubber foam were investigating plastics intensively.

In school furniture, again it was molded reinforced plastics parts (tough enough to withstand the challenge of active youngsters) that found increased usage in a field long dominated by wood and cast iron. At least three large manufacturers of school furniture are now producing new lines in which the durability, color range, seating comfort, and easy maintenance of reinforced plastics play an important role. Two of the lines feature desk chairs with reinforced plastics contoured backrests that adjust easily to fit the posture of the student (MPL, Apr. '55, p. 98); the third manufacturer produces a line of classroom furniture with both seat backs and desk tops molded of reinforced plastics. More than 3000 of the latter desk-and-seat units have already been placed in schools in the Chicago area.

In the field of case goods, talk again centered around the commercial possibilities inherent in the concept of rugged, warp-free all-plastics furniture drawers. Although such drawers have been under discussion for a good many years (and several versions have already been marketed), events of 1955 indicate that within the next few years, the plastics drawer may at last become a large-volume commercial feasibility. At the beginning of the year, for example, one experimental line of modernistic furniture was introduced that made extensive use of drawers vacuum formed of high-impact styrene sheet (MPL, Apr. '55, p. 87). By the end of the year, the concept of formed pieces was already being adapted by another manufacturer to the commercial production of vacuum formed styrene liners designed to fit into conventional wooden drawers. And a third manufacturer was experimenting with the idea of vacuum formed styrene drawer pulls (MPL, Aug. '55, p. 201).

Still a fourth manufacturer introduced a line of compression molded square-cornered drawers, using urea and phenolic materials. The faces of these drawers are decorated by molding-in printed melamine-impregnated sheets.—END

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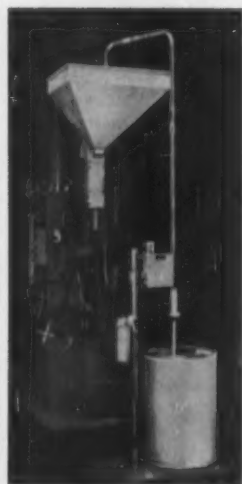
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**AUTOMATIC  
HOPPER LOADER**

## In Toys

(From pp. 107-108)

the original. Standing 17 in. high, 21 in. long, and 10 in. wide, the model, which is made up of rugged molded styrene parts, is available either fully assembled or in a "do-it-yourself" assembly kit.

Another of the outstanding toys in the field of realism in 1955 was an accurate model of a magnetic crane. Molded of tough acetate and operated by remote control, the crane is fully operative and places in the hands of the youngster a means of absorbing while at play a working knowledge of some of the basic principles of mechanics.

In an effort to heighten realism even more, plastics, in the form of tiny vinyl records produced at the rate of 2½ million units a year for use in compact hand-operated phonographs inserted in dolls, toy trucks, etc., were responsible for bringing a new "voice" to toys.

In the hobby field, the big use of molded styrene and acetate parts for model automobile assembly kits was supplemented in 1955 by a strong trend to the production of model boat and model plane assembly kits made up of parts realistically vacuum formed (right down to the most minute nails in hull or fuselage) from styrene sheet (MPL, Nov. '55, p. 113; May '55, p. 88). Because of the light weight of the tough, thin sheets, the boats or planes, when put together, can actually float or fly.

Considerable interest on the part of toy designers also focused on the new low-pressure polyethylenes. When the material is available in production quantities, it is expected to have an important effect on the design of trucks, model cars, and other toys for older children that require rigidity as well as high-impact strength.

The new polyethylenes, coupled with reinforced plastics (which continued to be used for model toy car bodies in 1955; MPL, July '53, p. 78), the high-impact styrenes, the vinyls, and the improved acetates should do much to push plastics in increasing quantities into the higher-priced toy brackets. More important, the success of these quality applications should help to increase consumer awareness and consumer acceptance of all plastics toys.—END

## In Signs

(From pp. 110-111)

vinyl or butyrate sheet) in displays designed to create the illusion of motion—a technique which found a large-volume market in subway car cards in 1955.

In addition, much of the development work being done on materials pointed to a continued expansion in the market for 1956. Improved vinyl and butyrate sheetings aimed specifically at the sign and display field were made available in 1955 and, reportedly, a new styrene sheeting that lithographs well and has good dimensional stability will be offered to the market in 1956.

Prospects for the expansion of plastics in the outdoor sign and display field also look good. As in the past, the acrylics and the polyester-fibrous glass laminates are major factors in this phase of the industry. In 1955, improved materials and improved fabricating techniques were translated into signs and displays of record size and unparalleled eye appeal. Among the acrylic signs, a weather ball (for forecasting weather conditions by changing colors), spherical in shape, 15 ft. in diameter, and made up of 88 acrylic panels supported by steel frames, attracted considerable attention; among the reinforced plastics displays, a huge model Hereford bull standing 11 ft., 8 in. from hoof to horn and 19 ft., 7 in. from nose to tail held the spotlight. Molded in thirty-nine ¼ in. thick sections, the translucent plastic "skin" of the bull is attached to a steel framework by flexible rods.

Many display houses are also experimenting with the new outdoor butyrate sheeting announced in 1954. Several vacuum formed signs are already on the market (MPL, Apr. '55, p. 87) and one display house is reported to be adapting three-dimensional formed parts to the design of an outdoor billboard poster.

Another potentially large-volume market for outdoor plastics is in the heretofore relatively unexploited field of highway signs (MPL, June '55, p. 96). Again it was acrylic (particularly for translucent lettering and reflecting signs) and reinforced plastics that took most of the market in 1955.—END



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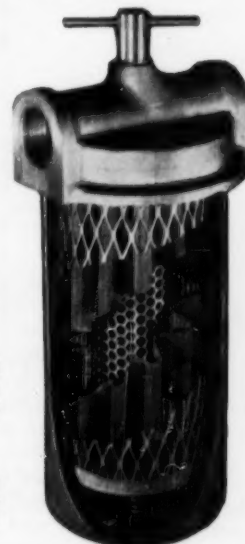
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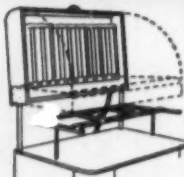
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Progress in Plastics

## In Electronics

(From page 113)

to stimulate research on the part of manufacturers of electrical equipment in the development of new formulations to meet specialized requirements. The chemical research department of a manufacturer of transformers, for example, reported in 1955 on the development of a special formulation based on a new curing agent which is claimed to impart higher impact resistance and better electrical characteristics than were previously possible.

As insulation for capacitors, polyester film developed into a prime material in the electrical industry in 1955 (MPL, Nov. '55, p. 85). The capacitor units, so important to all electronic devices, can now be made smaller, yet can be operated over a wider temperature range than models based on paper insulation.

In one typical application, a small fractional-horsepower motor in which the polyester film is used as slot and between-coils insulation, the fact that the film has 35 times

the moisture resistance and 8 times the dielectric strength of paper made it possible make the motor 40% smaller and 50% lighter.

In other electrical applications involving polyester film, the development of techniques for laminating polyester film to other less-expensive films indicated that the material will probably find wide use in improving and miniaturizing electrical equipment where cost is a dominant factor. One such application introduced in 1955 was a tiny battery in which a stack of small wafers of a power-producing material are wrapped in a polyester-Pliofilm laminate, heat-sealed, and inserted in an aluminum tube.

Use of printed circuitry in 1955 also increased in electronic computers, industrial control units, servo-mechanisms, and similar equipment.

A good deal of this new development work centered on epoxy-fibrous glass laminate as the base material for printed circuits. The laminate has very low moisture absorption, high arc resistance, high temperature resistance, and low dielectric loss. In addition, because the

epoxy resins are excellent adhesives, no special bonding film or adhesive coatings are required.

Another new material that has aroused interest is a moldable phenolic-impregnated cellulose fiber sheet, with epoxy resin applied to both surfaces to further improve electrical characteristics. Because the material can be formed to three-dimensional shapes, it allows greatly increased flexibility in the design of printed circuits. Increased thickness at mounting corners, reinforcing ribs to strengthen thin sections, and other three-dimensional effects can be incorporated.

A third development was a new translucent laminate for printed circuitry which, because of its cold-punching qualities, requires no heat cycle and is consequently less subject to dimensional change. The translucency is also a useful characteristic. By holding the laminate to the light, it is possible to see whether resin pockets, voids, or other imperfections are present and whether the circuit on one side of the laminate registers with that on the other.—END


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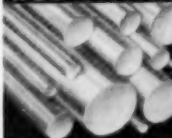


Thickness Inches	Nominal Size
1/4	12 x 12
1/2	18 x 18
3/4	24 x 24
1	36 x 36†
1 1/4	48 x 48†
3/4	
1/2 & Up	

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3/8
1/2
3/4
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1 1/4
1 1/2
1 3/4
2
2 1/4
2 1/2
3

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3/4	1/2
1	3/4
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2 1/2	1 1/2
3	1 3/4

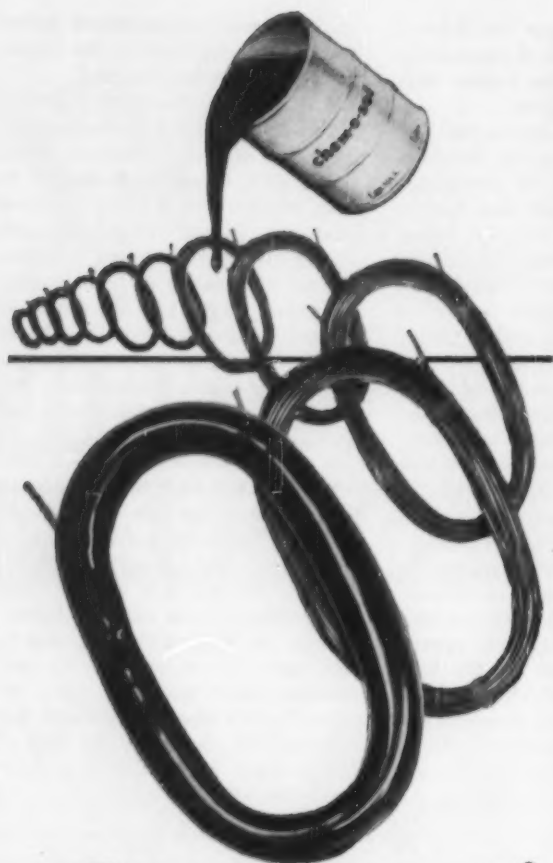
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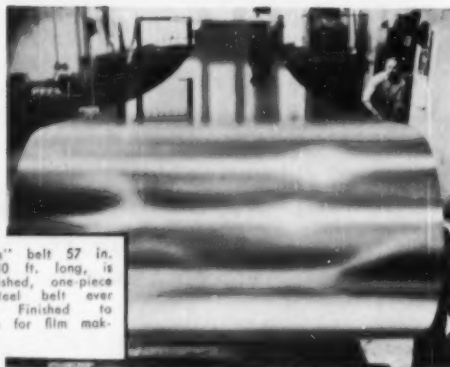
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Modern Plastics

## Engineering

(From pp. 115-130)

terials, resulting in products that will be lower in initial cost and will require less maintenance.

**Treating for Printing**—Stanley F. Bloyer in an article, "Treating Polyethylene for Printing," published in July, described the several existing methods by which polyethylene surfaces can be prepared for ink adhesion. These methods are:

1) "stretching," which involves physical reorientation of the material by stretching in the cold state;

2) chemical etching, which makes use of a chemical bath to etch the surface, thus providing relief from surface tension as well as giving an enormously greater contact area upon which the ink is supposed to be able to get a "tooth;"

3) heat differential, wherein the apparent effect is the release of surface tension through the application of heat by subjecting the surface to a hot blast of air for a relatively short period of time;

4) energy impingement, in which the relatively unstable nitrogen atoms are caused to leave the compound, resulting in a substantially unsaturated surface. This can be accomplished by either the electron bombardment (patents pending) or the flame contact method (M. F. Kritchever patents No. 2,648,097, No. 2,683,894).

The author pointed out that careful consideration should be given to several different factors before selecting a process for the treatment of polyethylene and, because of the technical problems involved and the fact that some or all of the processes are patented, he advised that it was best to seek experienced advice.

### Reinforced Plastics

F. W. Reynolds and L. N. Chellis, in an article entitled "Vinyl Plus Reinforced Plastics," published in the December issue, gave a complete report of the results of extensive research focused on finding solutions to the problems inherent in combining vinyl sheeting and reinforced plastics in the form of a laminate for business machine housings. (See Fig. 16, p. 128.)

The first part of the study proved

that, from the standpoint of the manufacturer of business machines, there are many advantages of vinyl-to-reinforced plastics laminate construction over painted steel and/or vinyl-to-metal laminates, namely: lighter weight, high resistance to denting, improved sound reduction, greater flexibility in design, an appreciable reduction in tooling costs, lower unit cost, reduced maintenance problems, resistance to cigarette burns, greater bond strength (as compared to vinyl-to-metal laminates), and superior stretch and abrasion resistance.

The study also brought out the fact that the major disadvantages are the low heat dissipation factor and the problem of providing a medium for radio-interference elimination—both of which are far outweighed by the many advantages.

The second stage of the research involved solving several different problems in design, production, and finishing. These problems were:

1) designing a part consistent with the process limitations imposed by the materials;

2) developing a supported or unsupported, embossed and calendered vinyl overlay sheet that could be satisfactorily bonded to the polyester-fibrous glass during molding;

3) formulating the resin for low-temperature cure in economical cure time;

4) establishing proper molding techniques for producing parts that:

a) are free from pattern distortion, b) are free of wrinkles in the vinyl sheeting, and c) meet rigid quality standards;

5) attaching stiffeners and metal fasteners to the vinyl-fibrous glass housings;

6) developing satisfactory and economical molding materials; and

7) devising methods for low-cost finishing and assembling.

The authors related step-by-step operations which were pursued until the finally successful results were obtained. These results clearly indicate that the vinyl-to-metal laminate can be produced on a practical and economical basis. As a result, the International Business Machines Corp. is now turning out, on a pilot-plant scale, vinyl-to-reinforced plastics laminate business machine covers for field evaluation. At the present time, the covers are intended for use on the IBM 086 High Speed Card

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Sorter, but other models based on the laminate construction are expected to be released for production in the near future.

**Premixes**—In an article, "Reinforced Polyester Premixes," by W. O. Erickson and W. R. Ahrberg, in the November issue, the subject of "gunk" molding materials was covered from the standpoints of: 1) how to make them, 2) what to make them of, 3) how to mold them, 4) recommended design features for parts, 5) how to handle the "just molded" part, and 6) how to finish them.

**Jet Plane Fuel Cell**—Published in the October issue, "Protection for Jet Plane Fuel Cells" described a unique application for molded reinforced plastics as liners for fuel cell compartments (Fig. 17, p. 128) of the Grumman F9F-8 Cougar fighter plane. The components for each cell consist of three parts, each being made of two layers of fibrous glass cloth, except those sections adjacent to the access ports which are "beefed up" with several additional layers. Descriptions of the cast phe-

nolic mold, lay-up and molding methods, finishing, and assembly were included.

**Air Bottles**—"High-Pressure Air in Reinforced Plastics Bottles," by Daniel Mapes, in October, briefly described the successful production methods used for testing of spherically shaped reinforced plastics compressed air reservoirs which will safely hold 650 cu. in. of air under a pressure of 3000 p.s.i. This plastics reservoir weighs only 12¼ lb. as compared to an equivalent wire-bound 20¼-lb. steel sphere.

### Quality Control

"Quality Control for Custom Molders," by John B. Whitted, Jr., published in the November issue, is a down-to-earth treatise which presents a "package" plan, stripped of the symbolism of higher mathematics, that the practical engineer can readily apply to up-grade the quality of molded plastics parts.

This "package" deals with thermosetting molding but is equally applicable to thermoplastics molding

procedures. It starts at the very beginning of a plastics project; namely, the quotation on a new job. The text then traces the problems of designing the mold, obtaining first part samples, and establishes methods of in-process controlling of quality.

The author points out that if the outlined program is followed, the following results can be achieved:

1) It can be determined before quoting that the part can be molded to the customer's specifications, or he can be advised of any tolerance modifications necessary.

2) The precise shrinkage allowance required for construction of the mold can be predicted accurately.

3) The exact tolerance which can be allowed in the construction of the mold can be determined in advance.

4) It can be determined that samples submitted to the customer are "typical" of those which the mold can be expected to produce.

5) Errors, if any exist, can be properly evaluated.

6) In-process controls can be instituted where necessary, providing considerable reject insurance.

7) Scientific sampling techniques



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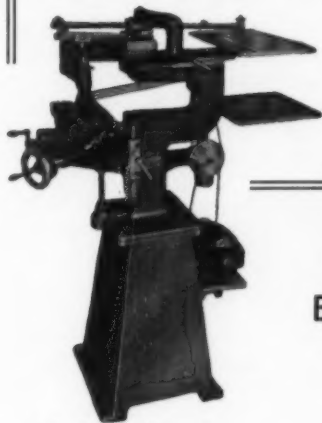
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8) Finally, and perhaps most important, a more thorough understanding of the capabilities and limitations of the molding process can be acquired. (See Fig. 18, p. 130.)

### Decorating

"Color, Paint, and Plastics," by Lloyd E. Parks, in the May issue, is probably the most comprehensive article ever published on the subject of applying color to plastics by spraying and silk screening. The author described finishes used in vacuum metallizing of plastics.

The differences in application methods for lacquer and enamels were discussed, as were also certain important properties which must be considered before deciding on the exact composition of the lacquer or enamel to be used. The specific properties needed for paints or inks for silk screening were described.

Many different causes for rejections or poor-quality products may result from the improper use of "paints" or of incorrect composition

for the material to which they are applied. Such problems as "humidity blush," "etching," "crazing," "orange peel," "cobwebbing," "plasticizer migration," and "adhesion" were thoroughly covered.

The author summarized by stating that many products are available for painting plastics and that no paint meets every possible requirement. Compromises must be made and the best that one can do is formulate for as many good points as possible and adjust for shortcomings as they arise.

### Miscellaneous

In addition to the foregoing, several other articles were published:

"Styrene Patterns for Investment Casting," by Richard A. Pereles, October issue, brought up-to-date the use of injection molded styrene patterns in the so-called "lost wax" process of precision casting.

"Where and How to Use Epoxies," by Jerome Formo and Luther Bolstad, July issue, outlined practical details on applications of epoxy resins in coatings, adhesives, castings, moldings, and foams.

"Drop Hammer Dies," August issue, used an example of a die for forming aluminum, to spell out the techniques of producing a drop hammer die from aluminum-filled epoxy.

In the September issue, Robert L. Hibbard, in an article "Forming Teflon for Electrical Uses," stated that several misconceptions regarding the forming of Teflon are without foundation. He cited several examples to indicate the possibilities of forming this material.

"Preforming Polytetrafluoroethylene," March issue, explained how, by the use of a shutter device fed by a special agitator type of hopper, preforms can be automatically produced with a weight variation of not more than  $\pm 2$  percent.

In the October issue, Walter Donges, in an article "Making Inflatables Continuously," explained the details of applying a printed layer of non-adhesive material to vinyl film in such a way that the production of inflatable items such as mattresses, bathing toys, etc., can be performed continuously without the use of electronic heat sealing equipment.—END

## S.P.E. Conference

(From pp. 131-132)

polymerization, softening point, and processing latitudes of formulated compounds.

**Physical Properties of Unmodified Rigid P.V.C.,** by F. W. Schneider, Firestone Plastics Co. Properties such as tensile, flexural, and compressive strength and moduli, impact resistance, and heat distortion, as well as electrical and thermal properties, are presented. Tables and graphs are shown by slides.

**Injection Molding Research—Today and Tomorrow,** by J. Eveland, H. J. Karam, and C. E. Beyer, The Dow Chemical Co. Research information is presented concerning heat fabrication properties of thermoplastics, particularly as such information has been applied to the improvement of materials, machines, molds, and molded products.

**Tensile Impact—A Simple, Meaningful Impact Test,** by C. G. Bragaw,

Jr., Du Pont. A modification of the Izod impact tester makes it possible to run tests on molded parts, films, filaments, and machined structures. This report shows that these tensile impact strength tests can be correlated with use tests.

### EXTRUSION SESSION

*Moderator, Hans Buecken, National Rubber Machinery Co.*

**Trends and Problems in European Extruder Design,** by E. Gaspar, Projectile and Engineering Co. Comparison of single- versus multi-screw extruders, and advantages and disadvantages of adiabatic extrusion, as well as length/diameter ratios on single-screw machines, are presented in addition to suggestions as to screw designs and screw speeds.

**Viscosity Data for Extruder Flow Equations,** by Robert D. Sackett, Monsanto Chemical Co. Theory, equipment, and test data for determining and applying "apparent extrusion viscosity" are shown and values are reported for polystyrene, butyrate, vinyl, and styrene acrylonitrile.

**A New Development in Extrusion-Extrusion: The Vacuum Extruder Screw,** by Ernest C. Bernhardt, Du Pont. A description is presented of the construction, operation, and advantages of a new type of extruder screw which allows volatiles to separate and be subsequently removed on a continuous basis.

**Melt Fracture Roughness in Plastics Extrusion,** by J. P. Tordella, Du Pont. Melt fracture gives rise to spiral, wavy, and segmented extrudates and is one of the causes of rough or irregularly shaped extrusions. Melt fracture is described as a function of temperature for Zytel, Alathon, Teflon, and Lucite.

### CALENDERING AND COATING SESSION

*Moderator, J. Leavy, Du Pont.*

**Coating Equipment,** by Dale G. Higgins, John Waldron Corp. Spread-coating techniques are described and illustrated by slides, with special reference to new methods borrowed from paper coating.

**The Calendering of Vinyl Sheet,** by E. F. Wuest, Masland Durable Leather

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Co. The discussion is taken step by step through all processes from raw material to finished sheeting. Pigment grinding, color control, Banbury mixing, milling, and calendering are described in detail.

**Calendering Equipment**, by R. C. Seanor, Adamson United Co. A history of calendering techniques and problems also describes present day advances in rolls, journals, and bearings; temperature controls, speed of production, and control mechanisms.

**Fabric Coating Techniques**, by E. G. Hamway, Textileather Co. A general discussion is given of present day materials and techniques used in the manufacture of plastics-coated fabrics. Future possibilities are summarized and factors governing growth are set forth.

### REINFORCEMENT OF PLASTICS SESSION

Moderator, Roger White, Glastic Corp.

**Non-Glass Reinforcement of Plastics**, by Johan Bjorksten, Bjorksten Labs. A review is presented of the principal types of non-glass rein-

forcement (cellulose, asbestos, nylon, etc.), listing pertinent properties, present and future applications, and the development problems of each.

**Reinforced High-Impact Plastics**, by Paul Fina, Fiberite Corp. Choices of resins, fillers, and molding properties are reviewed.

**Asbestos Reinforced Plastic Laminates**, by D. V. Rosato, Raybestos-Manhattan, Inc. The use of asbestos in various forms and types as reinforcements for plastics and the resultant mechanical properties are presented.

**Reinforced Plastics in the Construction of External Pressure Vessels**, by F. R. Barnet and C. L. Lloyd, U. S. Naval Ordnance. The characteristics of glass-reinforced plastics are determined and are related to problems encountered in producing housings capable of resisting extreme external hydrostatic pressures.

### PLASTIC FOAMS SESSION

Moderator, E. J. Baruth, Brown Rubber Co.

**Chemically Blown Foam**, by H. E.

Arnold, Du Pont. A non-discoloring, non-staining, nitrogen-releasing blowing agent to produce both closed and open cell type P.V.C. foam is discussed, particularly as to formulating and processing.

**Isocyanate Foams**, by Dr. C. J. Harrington, Du Pont. This technical presentation of rigid insulating and resilient cushioning polyurethane foams shows their properties and present and future applications.

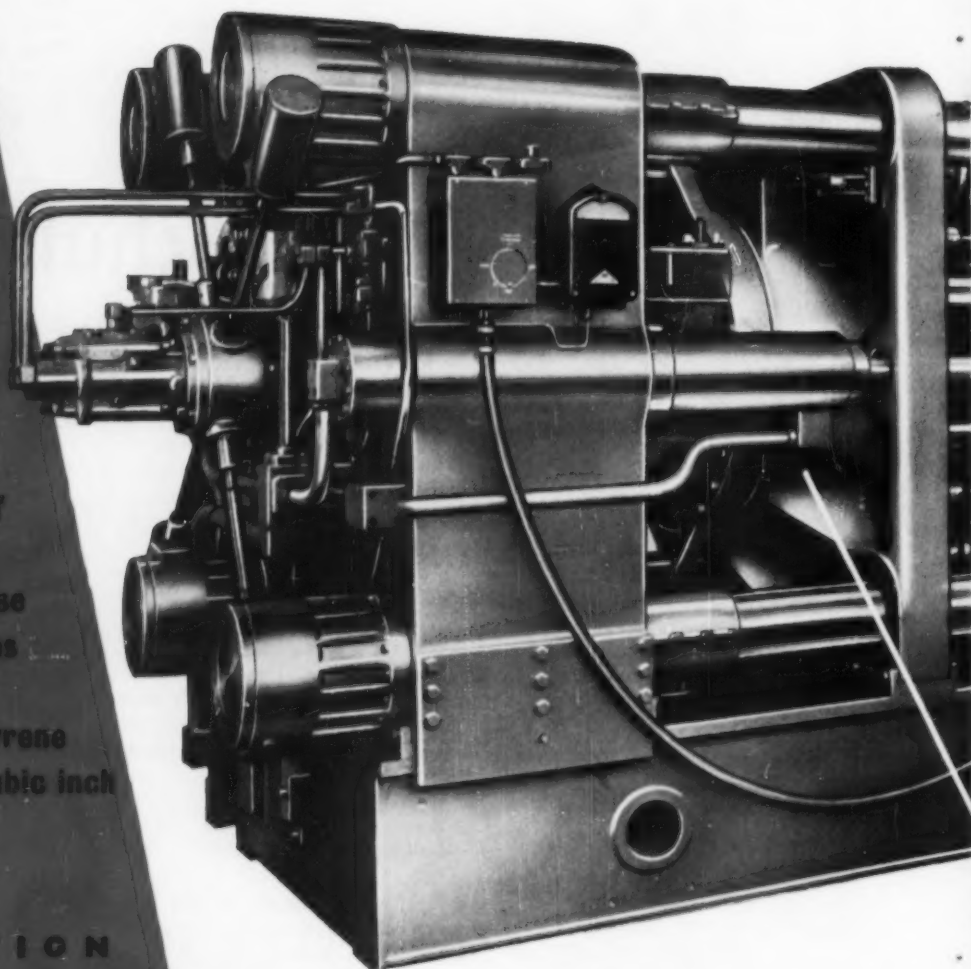
**Gas Injection Vinyl Foam**, by H. F. Allen, Elastomer Corp. A presentation is given of the growth, present status, and future potentials of the vinyl foam industry. Specifically pointing out techniques, applications, and materials, the paper covers a field of wide scope and increasing possibilities.

**Expanded Polystyrene—Fabrication Methods and Applications**, by G. R. Franson, The Dow Chemical Co. Types of polymers, formulations, expanding agents, fabrication techniques, molding, heating and  
(To page 232)

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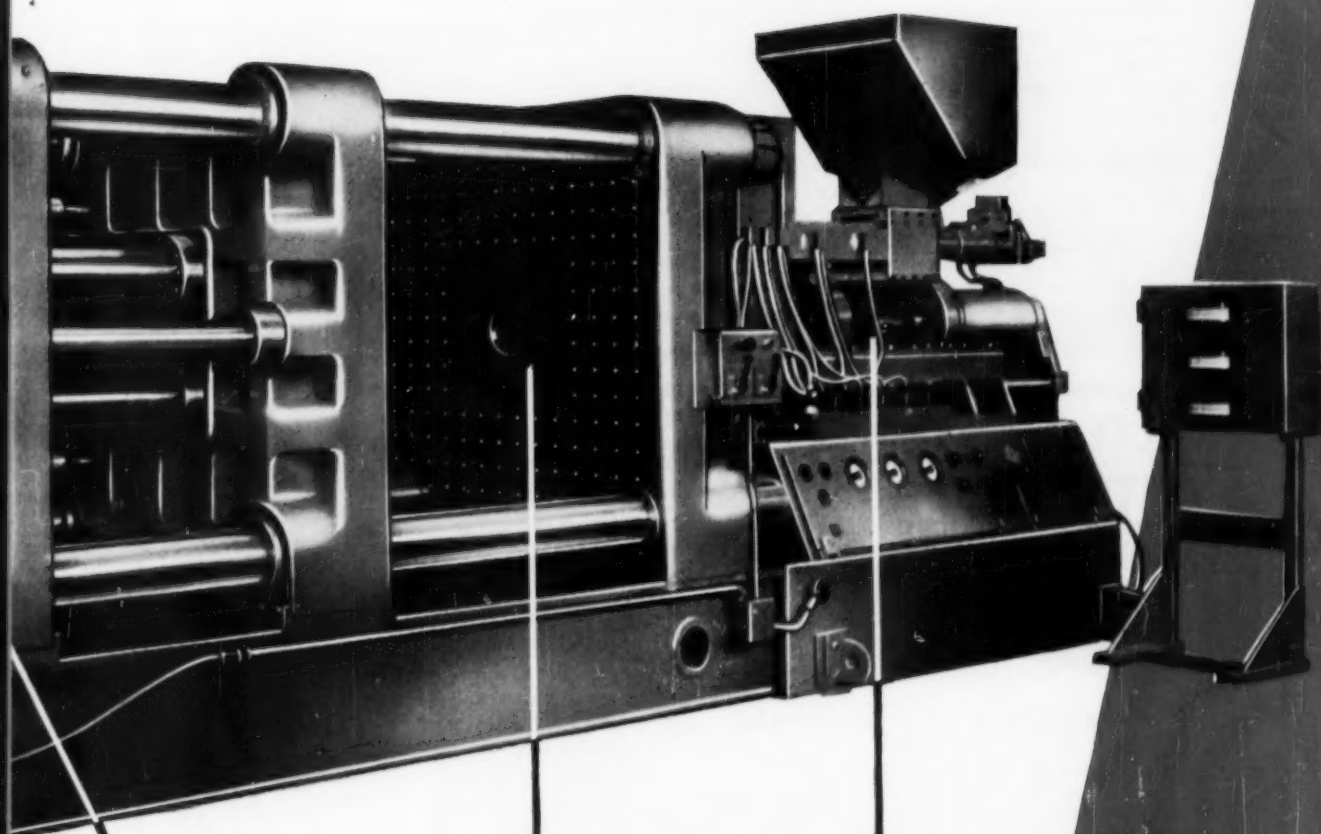
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#### PLASTIC PIPE SYMPOSIUM

*Moderator, George Anderson, National Tube Co.*

**Cellulose Acetate Butyrate Pipe**, by R. J. Scogin and L. W. A. Meyer, Tennessee-Eastman Co. In addition to presenting properties, applications, and fabrication techniques of butyrate pipe, test data on long term creep at two temperature levels, impact shrinkage, and burst strength properties are reviewed.

**Kralastic Pipe**, by P. M. Elliott, Naugatuck Chemical, Div. U. S. Rubber. Applications, properties, and advantages of the acrylonitrile copolymer blend are presented, as are also fabrication techniques and future possibilities.

**Rigid Polyvinyl Chloride Pipe**, by J. F. Malon, B. F. Goodrich Chemical Co. A discussion of the rigid vinyl pipe market in the United States—including types used, physical and chemical properties, and production methods—is followed by

an analysis of present and future applications.

**Polyethylene Pipe**, by C. G. Bragaw, Du Pont. The utilitarian aspects and service experience are reviewed, and typical pipe creep data are presented for commercial polyethylenes. Factors affecting creep fracture are considered.

#### REINFORCED PLASTICS SESSION

*Moderator, Brandt Goldsworthy, Industrial Plastics Corp.*

**Present and Future Applications of Reinforced Plastics in Aircraft and Guided Missiles**, by William E. Braham, Zenith Aircraft. (Abstract not available at the time of going to press.)

**Problems Encountered in Tooling World's Largest Airborne Reinforced Plastics Component**, by N. A. Nicholson, Zenith Aircraft. The lower radome for the Super Constellation posed many difficult problems, largely because of its size and the complex tooling problems involved. Basic mechanical properties of reinforced plastics, control of di-

mensions, and tolerances, distortion, and other factors are considered.

**Tooling for Large Radomes**, by R. F. Vreeland, Hughes Aircraft Co. The problems of die development are discussed as they pertain to the high-pressure molding of laminated fibrous glass radomes.

**Applications of Plastics in Marine Cathodic Protection Systems**, by M. Stander and H. Preiser, U. S. Navy, Bureau of Ships. Reinforced epoxies, rigid P.V.C., polyethylene, and others, as components in marine cathodic protection systems, are discussed and performance-evaluated.

**Fire Retardant Electrical Grade Polyester Laminates**, by J. K. Allen, Westinghouse Electric Co. Laminates containing two different fillers and two different polyesters are compared as to burning rates and electrical properties.

#### MATERIALS SYMPOSIUM

*Moderator, Adolph Kisseleff.*

**The Effects of Fabrication on the Properties of Teflon Tetrafluoroeth-**

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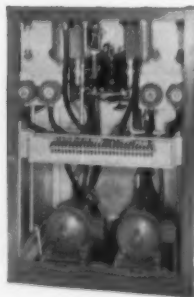
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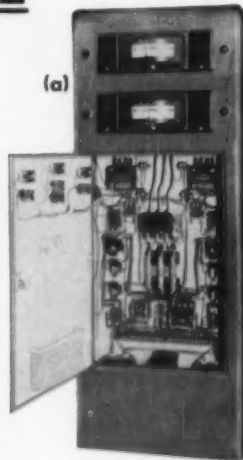
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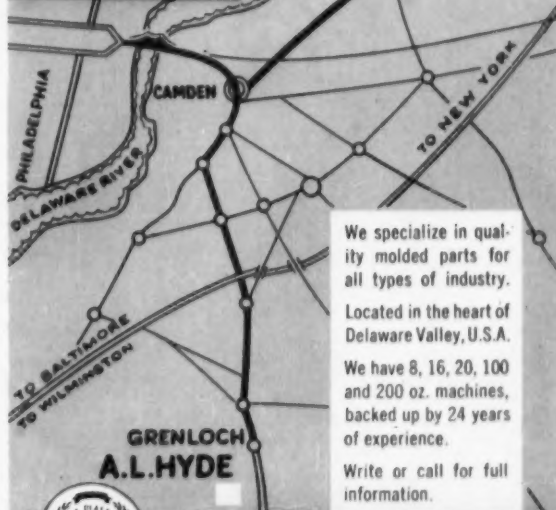
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**Super Polyethylenes**, by George H. Sollenberger, Koppers Co., Inc. A discussion of the possibilities of new applications by the use of super polyethylenes is followed by a comparison of the properties of the super and the conventional polyethylenes.

**Silicone Product Development**, by Dr. L. E. Weisbecker, Bakelite Co. The story of the problems encountered in the development of silicone resins and molding materials is outlined, and future potentialities are surveyed.

**Cellulose Propionate Molding Compounds**, by D. Jones, Celanese Corp. of America. The availability of

propionic acid, as well as improved plasticizers, have made Forticel a production reality. Properties and applications are discussed with relation to use as an injection molding material.

**Polyethylene—Past and Future**, by G. N. Jargstorff and George F. Kirkpatrick, Bakelite Co. Comparisons of conventional polyethylenes with a selected number of new polymers are made on the basis of properties and applications to old and new fields.

### DESIGN SYMPOSIUM

Moderator, Otto Wulfer, Wagner Electric Co.

**Designing With Transparent Plastics**, by A. M. Blumenfeld, Rohm & Haas Co. Design problems when utilizing clear plastics are compared to problems encountered with opaque materials. Suggestions are offered as to form, composition, and treatment. A case study of automotive escutcheons is presented.

**Definitive Specifications for Plastic Materials of Construction**,

by W. C. Wall and R. E. Brooks, Du Pont. The establishment of specifications for nylon molding powder is used as an example to show the importance of molecular structure, purity, and processing characteristics as they pertain to quality control during manufacture and subsequent fabrication.

**Designing With Zytel Nylon Resin**, by A. J. Cheney, Du Pont. Principles of machine design and properties of Zytel nylon resins as considered in design problems are graphically described in terms of strength, deformation, and stiffness properties.

**Analysis and Solution of Painting and Metallizing Problems**, by Lloyd E. Parks, Logo, Inc. Procedures for analyzing and solving problems of decorating plastic parts, such as adhesion, gloss failure, dry time, etch, heat distortion, and film irregularities, are discussed and illustrated by slides.

**Educational Committee Forum**; Moderator, Jules Lindau, III. Subject: Training of Plastics Engineers.

## 1955 in Review

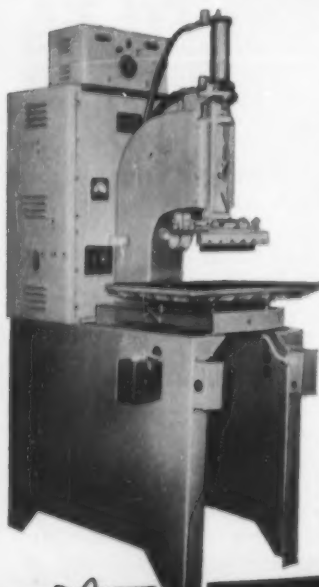
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299. "New approach to plastics structures," *Modern Plastics* 32, 92-93, 218, 220 (Dec. 1955).
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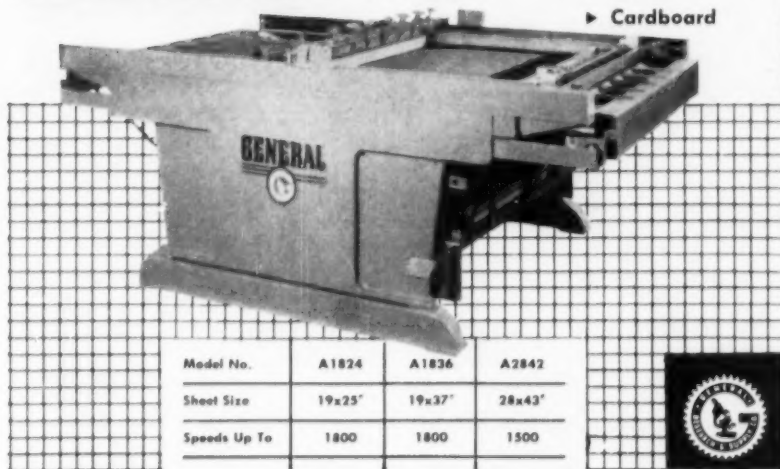
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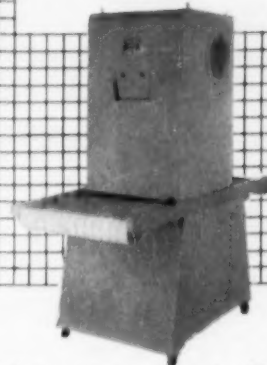
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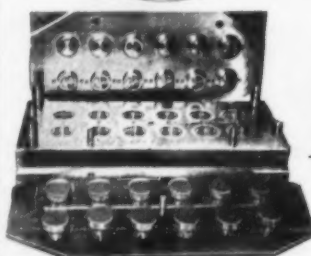
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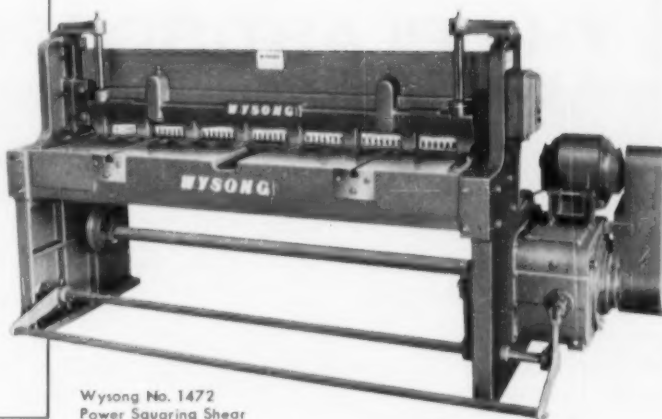
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# THE PLASTISCOPE\*

NEWS AND INTERPRETATIONS OF THE NEWS

By R. L. Van Boskirk

## Hercules Introduces New Plastic From Pentaerythritol

SOMETHING new and quite different from anything now on the market in plastics is a new resin called Penton. It is produced from pentaerythritol by Hercules Powder Co., Inc., Wilmington 99, Del. The polymers are characterized chemically as chlorinated polyethers. The product is in the development stage, with a pilot plant in operation at the Hercules Experiment Station. The capacity of this unit is several tons per month. Development price of the product is \$6.00 per lb. f.o.b. Parlin, N. J. That price may get down to as low as \$2.00 a pound as soon as extensive commercial production gets under way.

Penton offers unusual dimensional stability characteristics. The product is easily injection molded on commercial equipment, and no special steel is required in cylinders or molds. Hot molds (190° F.) are utilized, but for a different reason than with other thermoplastics. With Penton it has been determined that optimum rate of crystallization exists at 190° F., and thus the product hardens through this process rather than solely through the removal of heat. A cold-mold temperature (140° F.) will extend cycle time by a factor of three or four. This phenomenon of hardening, which allows for elimination of all strain within the molded piece, coupled with the low water absorption (0.01%), accounts for the material's excellent dimensional stability.

Molding cycles range from 20 sec. or less for wall sections up to 1/16 in. thick; sections of 1/4 to 1/2 in. can be molded in 80 sec. or less. The material can be readily handled in extrusion machines. Extrusions have been made into sheet stock of 0.005- to 0.0030-in. thickness, into rod of 0.010- to 0.375-in. diameter, and into

pipe or tubing of 1/16- to 3/4-in. inside diameter.

Heat distortion point at 264 p.s.i. is about 185° F.—at 66 p.s.i. it is about 300° F. Specific gravity is 1.4. Mold shrinkage is 0.004 to 0.006 in./

### NEXT MONTH'S PLASTISCOPE

For the convenience of our readers, a major change in the presentation of this department of *MODERN PLASTICS* Magazine will be inaugurated with our February 1956 issue. Terse comment on the most recent happenings that are important to the plastics industry will appear in large, easy-to-read type, in a section printed on colored stock well up front in the magazine.

Especially to operating heads of businesses, this change would be a boon since it will give them the latest and most important news at a glance.

In its customary position in the back of the book, the *Plastiscope* section will be continued, carrying its usual sub-departments and more details and interpretations of the news of the month.

inch. As now made, Penton is a straw-colored, semi-translucent material. Because of this color, bright pastels, particularly in blue shades, are difficult to make. All other colors and whites are possible.

The chemical resistance of Penton to both inorganic and organic agents offers an advance over previously available materials. Its chemical resistance, plus its high heat distortion point, now makes it possible to handle end uses at elevated temperatures (212 to 257° F.) which previously required higher cost compounds.

The markets for the product are now in the process of being determined. Many of them are in the

same field as fluorocarbons. Its properties indicate that such fields as the following will be successfully exploited: fluid meter gears and bearings; valves for chemical, water, and low-pressure steam pipes; bearing and gear applications in business machines requiring a high degree of dimensional stability; electrical insulation and valves in refrigeration; and film wherever high tensile strength (25,000 p.s.i.), transparency, and impermeability are required.

Pentaerythritol from which Penton is derived is rapidly becoming a most useful chemical base for various products. In wartime it is a useful ingredient in explosives such as PETN. Its greatest commercial use is in paint where it is used with alkyd resins for protective coatings and for fortifying quick-drying vegetable oils; also as a fire retardant for paints or lacquers that are used for wall board. Another use is in treatment of core oils. The newest use aside from the above Penton resin is for a new line of plasticizers for vinyl chloride that Hercules has just introduced to the trade.

Pentaerythritol is derived from formaldehyde and acid aldehyde—behind those two are methanol and ethyl alcohol. Obviously, raw materials for its production are plentiful and reasonably low cost.

### U.S.I. Isosebacic Acid

THE first commercial plant in the world for the production of isomers of sebacic acid, known as U.S.I. Isosebacic acid, will be built in Tuscola, Ill., by U. S. Industrial Chemicals Co., Div. of National Distillers Products Corp., 99 Park Ave., New York 16, N. Y. Completion of the plant is scheduled for early 1957 and initial production capacity is expected to be 10 million lb. per year.

The new product is a mixture of isomers of sebacic acid in approximately the following proportions: 2-ethyl suberic acid, 72 to 80%; 2,4-diethyl adipic acid, 12 to 18%; and sebacic acid, 6 to 10 percent.

U.S.I. Isosebacic acid is the result of more than three years of research which began under the auspices of a National Distillers' fellowship at the University of Cincinnati and progressed through the company's research laboratory. The product has been in pilot-plant production for the past two years, first at

\* Reg. U. S. Pat. Off.

*"Millionaires and movie stars...move over!"*



Sections of 42-foot pool made with RCI POLYLITE polyester resin are set in excavation. Overlapping seams are "welded" with resin; then screws are added. With concrete coping set and filter system connected, pool is ready to fill!



## Inexpensive, durable swimming pool made with RCI PolyLite polyester resin

• The permanent plastic pool you see here makes backyard swimming a practical luxury for thousands of families...practical because of the big advantages in construction of RCI POLYLITE polyester resin reinforced with fibrous glass.

The preformed pool weighs only about 1100 pounds and is easily assembled. It's practically indestructible and has "built-in" color. It's easy to clean, won't leak or crack. And it's highly resistant to chemicals. Pool sections are made by

W. R. Chance & Associates in Arlington, Virginia, for distribution by Delorich Enterprises, Inc. of North Miami, Florida.

Perhaps the combination of lightweight strength, durability and easy maintenance you get with RCI POLYLITE and fibrous glass construction can be incorporated into one of your products. Why not find out more about what you can do with RCI POLYLITE for laminating, molding and other applications? Write for Booklet A.

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REICHHOLD CHEMICALS, INC., RCI BUILDING, WHITE PLAINS, N. Y.

# THE PLASTISCOPE

U.S.I.'s former Fairfield plant and more recently in new pilot plant facilities at the Cincinnati Research Laboratory.

Over 400 research laboratories already have received samples of the material for evaluation. The product shows promise as a raw material for vinyl resin plasticizers with good low-volatility, non-migration, and low-temperature characteristics.

Other promising applications include: production of polyamide (nylon type) molding and extrusion plastics and adhesives; alkyd resin manufacture to impart flexibility and water resistance to the surface-coating film; the synthesis of ester lubricants of the type used in jet-propelled aircraft; production of polyester resins used in the manufacture of glass-reinforced plastics; and the synthesis of polyurethane resins for foamed plastics, synthetic rubber, and protective coatings.

The principal raw materials used are butadiene and sodium, of which U.S.I. is an important producer. Tuscola was chosen as the location for the new plant because of the availability of raw materials at this site—hydrocarbons from National Petro-Chemicals Corp. as well as sulfuric acid and other raw materials from the adjacent U.S.I. installation.

## Dry Colorants and Concentrates

**A**N EXTENSIVE expansion program centering around the manufacture of concentrated pigment dispersions and a complete line of specially prepared dry colorants for thermoplastic molding compounds has been announced by American Molding Powder & Chemical Co., Div. of A. Bamberger Corp., 703 Bedford Ave., Brooklyn 6, N. Y.

The newly developed concentrates will be marketed under the trade-name Master Color; the dry colorants under Kromaplast.

Master Color will be used primarily with polyethylene and vinyl. The first concentrated dispersion to be offered will be a jet black which conforms to the most rigid dispersion requirements of Bell Telephone Laboratory specifications. It is suitable for such applications as sub-

marine cable, pipe, etc., where the destructive effects of aging are present. Additional Master Color dispersions are being developed.

Kromaplast dry colorants for general-purpose and high-impact polystyrene and polyethylene has a color range that will include all standards to approximate P.S.P. requirements, and special effects.

Because of its recent affiliation with Ansbacher-Siegle Corp., a pigment producer, American now has at its disposal Ansbacher-Siegle's technical knowledge and experience developed over years of color research. The firm is now basic in the dry colorant field from the actual pigment development and manufacture to the packaging and marketing of the finished dispersions.

With the manufacture of Master Color and Kromaplast, American is now in the position to custom compound polyethylene and vinyl using its own Master Color concentrated pigment dispersions. The company will specialize as sub-contractors to polyethylene and vinyl producers in color compounding.

The entire development and production of Master Color and Kromaplast is under the supervision of Edward J. Sheridan, Jr., former chief chemist of R-B-H Div., Interchemical Corp., and subsequently general manager of Sun Chemical Corp.'s Pigments Div. Until his recent appointment as vice president of American, Mr. Sheridan was associated with Ansbacher-Siegle.

## Mobay Starts Production

**O**PERATIONS have been started at Mobay Chemical Co.'s new multi-million-dollar plant at New Martinsville, W. Va., for the production of special type polyesters and isocyanates used for the manufacture of urethane. Urethane, produced commercially in Germany for more than five years, is used for both rigid and flexible foams, paints, wire coatings, adhesives, and synthetic rubber materials.

Construction of the plant started in January 1955 on a 100-acre site along the banks of the Ohio River. Mobay was formed in 1954 by Mon-

santo Chemical Co., St. Louis, Mo., and Farbenfabriken Bayer, A.G., of Leverkusen, Germany.

Currently, 150 persons are employed by Mobay at New Martinsville, including its 60-man research department, and the annual payroll will total more than three quarters of a million dollars.

## Teflon Price Reduction

**P**PRICE reductions ranging from 20¢ to \$1.50 a lb. on various commercial grades of Teflon have been announced by Du Pont's Polychemicals Dept., Wilmington, Del.

Teflon 1, a general-purpose molding and extrusion composition, has been reduced from \$5.10 to \$4.90 a lb.; Teflon 5, a special granulation for molding and extrusion, has been cut from \$5.35 to \$5.15 a lb.; Teflon 30, an aqueous dispersion used for coating and impregnating, has been reduced from \$7.00 to \$6.10 a lb.; and Teflon 6, a special extrusion grade being offered for the first time in commercial quantities, has been cut from \$9.50 to \$8.00 a pound.

## Board Surfacing

**T**WO new board surfacing resins for applying a decorative, protective plastic surface to low-cost structural boards by means of low-pressure laminating techniques were described in a paper delivered at the national plastics meeting of the Technical Association of the Pulp and Paper Industry at the Brooklyn Law School by Richard Lindenfelser and H. P. Ledden of American Cyanamid Co.'s Stamford Research Laboratories.

Designated as experimental resins PDL-1-2247 and PDL-1-2352, they will soon be available in sample quantities from Cyanamid's Plastics and Resins Div. These new modified triazine resin varnishes overcome the chief disadvantages of previous commercial surfacing methods, the authors reported. Surface properties of representative boards finished with the new resins approach those of standard decorative melamine laminates, they stated.

The surfaces are achieved as follows: Standard decorative print stock and overlay paper are treated with PDL-1-2247 and PDL-1-2352, respectively, on conventional equipment. The treated papers are completely dry and non-blocking and may easily be laminated to the sur-

face of hardboards such as Masonite or low-density particle boards like woodwaste or chipboard. A satisfactory curing cycle is 10 min. at 250 p.s.i., 300° F. No adhesive or balance sheets are necessary.

The same technique is also suitable for a new process—the finishing of fancy wood veneer-faced lumber core or plywood assembly by surfacing with a single resin-treated transparent overlay sheet. The entire assembly, including cross-banding plies, may be bonded and cured in a single low-pressure operation in conventional laminating or plywood presses.

Applications for these new resins are anticipated in wall panels, door panels, built-in cabinets, miscellaneous vertical surfacing, and other do-it-yourself applications, as well as in furniture construction, radio and television cabinets, chests, etc.

### Succinic Acid

**F**ORMERLY available only on a limited basis, succinic acid is now being marketed in commercial quantities by The Borden Co.'s Chemical Div., 350 Madison Ave., New York 17, N. Y.

One of the several organic polybasic acids manufactured by Borden's, succinic acid is used in the formulation of plasticizers, polyesters, alkyd resins, paints, pharmaceuticals, cosmetics, and chemical intermediates.

### More Useful Tubes

**A**N INTERNAL barrier coating for its polyethylene tubes which now makes it possible to package, with extended shelf-life, products like tooth pastes, shaving creams, and cosmetics without odor or flavor dissipation has been developed by Bradley Container Corp., Maynard, Mass. All Bradley products are marketed under the tradename Bracon.

Bradley Dewey, president, states that the internal barrier coating for Bradley squeeze-type tubes has proved to be effective for about 80% of the products which previously the firm had to reject for straight polyethylene packaging. The coating won't hold some of the organic solvents, but Mr. Dewey doesn't know of any packaging material that's good for everything.

The company is also offering a squeeze-type metal-ended polyethylene can in 8- to 32-oz. capaci-

ties. Called Bracon 2ME, the container can be filled from either end.

Bracon 2ME is aimed at providing squeeze-type packaging for large capacities at low costs. It has already created interest in the liquid detergent field, which is now divided between glass bottles and metal cans.

### Methyl Vinyl Ketone

**C**OMMERCIAL quantities of methyl vinyl ketone, a highly reactive chemical intermediate for the manufacture of plastics, adhesives, drugs, and chemical specialties, are now available from Chas. Pfizer & Co., 630 Flushing Ave., Brooklyn 6, N. Y.

The product can be stored for appreciable lengths of time without change in its properties. No difficulties with rapid polymerization of inhibited material has ever been encountered in the company's experience.

Chemically, methyl vinyl ketone is an alpha beta unsaturated ketone which functions as a diene in the Diels-Alder reaction in chemical synthesis. In addition, as a reactive monomer, it will also copolymerize with other monomers in the manufacture of plastic materials.

### Koppers-Brea Polyethylene

**P**LANs for the construction of a multi-million dollar plant, with a capacity to produce 50 million lb. per year of Ziegler-type polyethylene, have been announced by George M. Walker, vice president and general manager of the Chemical Div. of Koppers Co., Inc., and Homer Reed, president of Brea Chemicals, Inc., a subsidiary of Union Oil Co. of California.

The plant will be built on some site on the Pacific Coast which has not yet been announced. A joint engineering team is presently resolving the details concerned with location and operation. Completion of the new facility is scheduled for 1957.

### Plastics Fellowships

**F**ELLOWSHIPS with stipends from \$1500 to \$2100, plus tuition and fees, for graduate study and fundamental research in plastics are available from Princeton University, Princeton, N. J. The fellowships may lead to a degree of Master of Science in Engineering and are particularly suited to chemical, electrical,

and mechanical engineers, and to chemists and physicists.

Instruction covers properties, evaluation, production, fabrication, design, and application of materials, as well as the chemistry of plastics. The program includes lecture and laboratory classes, and contact with industrial plants representing various interests of the plastics industry.

Applicants for admission must hold a Bachelor's degree in engineering or physical science from a recognized institution and must meet general requirements of the Graduate School of Princeton University.

Further information regarding curriculum, fellowships, research assistantships, and application forms may be obtained from Louis F. Rahm, director, Plastics Laboratory, 30 Charlton Street, Princeton, N. J.

### Fluidized Coating

**C**ORROSION-RESISTANT coatings of polyethylenes, polyfluorocarbons, nylon, and other plastics on metallic and dissimilar plastic-molded targets can be provided by a new process announced by American Agile Corp., Maple Heights (Cleveland), Ohio.

The company states that before the new development, certain targets could be coated with polyethylene to provide corrosion-resistant surfaces by using special spraying equipment. However, many other targets could not be sprayed because of their small size and/or irregular shapes.

The development, known as the fluidized-coating process, is claimed to be a brand new concept in coating techniques. It involves the use of a powder fluidizer—a compact unit consisting of a specially designed gas distribution system which maintains the plastic powder in a turbulent dense fluid state. The appearance of the fluidized bed closely resembles that of a boiling liquid.

The fluidized-coating process provides a uniform coating up to  $\frac{3}{16}$  in. in thickness. The target to be coated is first preheated to predetermined temperature, then immersed in the fluidized plastic for from 10 to 15 seconds. It is then replaced in the oven and allowed to cure for a short period.

Expected applications for the new  
(To page 244)



# Multiple packaging is



## WHEN HOUSEWARE SETS WERE BAGGED IN POLYETHYLENE

Housewares molded of colorful Monsanto polyethylene are so attractive they are usually displayed on counters and left to sell themselves.

But dramatic things happened when one manufacturer tried the idea of packaging sets of housewares in printed polyethylene film bags . . . "Our sales in these items rose a phenomenal 1200%," says John Harkless, Sales Manager of Rogers Plastic Corporation, West Warren, Mass.

"The soft transparency of the polyethylene film makes the merchandise inside easily visible and far more appealing to the impulse shopper. But, more important, we can now design our line for higher unit sales, which is what every

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store manager wants. In addition to providing handsome packages, the polyethylene bags give the customer more re-use benefits, since they are tasteless, odorless, flexible and durable."

This is how the Rogers housewares line, one of the most extensive in the industry, met the demands of super merchandising.

**For other profit building ideas** on how you can upgrade your product lines with Monsanto polyethylene molding and film resins, write to Monsanto Chemical Company, Plastics Division, Dept. MP-1, Springfield 2, Massachusetts.

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process include the coating of interior surfaces of such items as pipe which requires corrosion-resistant protection but which must withstand pressures beyond the capacity of polyethylene pipe; flasks and containers with small-diameter neck openings, yet whose interiors require protection from corrosion; and flat but highly irregular shapes such as propellers, mixing blades, coaxial fans and rotors, and the like.

## Billion Pounds

**T**HE billionth pound of styrene monomer was produced at the Koppers, Pa., plant of Koppers Co., Inc. in November. When Koppers purchased the styrene plant in 1946, the capacity of the facilities was 75 million lb. of styrene a year; output is now more than double that of the original wartime facilities.

## Foilar

**A** COMBINATION of Mylar, foil, and vinyl has been perfected by Harlan V. Anderson, director of research of Rap-in-Wax Paper Co., 150 Twenty-sixth Ave., S.E., Minneapolis, Minn.

Designated as Foilar, the material combines the strength of Du Pont's Mylar polyester film, with the moisture-resistant qualities of aluminum foil and the heat-sealing excellence of vinyl film—all in one sheet, according to Mr. Anderson. The combination provides an inert barrier with extreme moisture, grease, and odor resistance. In addition to its good strength, moisture-resistance and heat-sealing qualities, Foilar structures are readily printable and can be manufactured to fit custom specifications.

## Linde Silicones

**S**IX new organo-silicone compounds with unusual lubricating and solubility properties have been developed by Linde Air Products Co., a Div. of Union Carbide and Carbon Corp., which recently opened up a new \$14 million silicone plant at Long Reach, about 35 miles north of Parkersburg, W. Va.

The silicone compounds are claimed to have many properties

which hitherto have not been available in the silicones. Like silicone oils, which are widely used in industrial products or processes, the new compounds have excellent mold release properties, special thermal and viscosity stability, and water repellency. In addition, they have lubrication and anti-wear properties that rival those of petroleum oil; the compounds can be used as emulsion breakers for oil products or as emulsifying agents under other conditions. Four are water soluble and two are easily soluble in both high and low aromatic solvents.

## Coating for Printed Circuitry

**T**RADENAMED Photofinish #4, a new, non-oxidizing, non-corrosive film which is claimed to protect and prolong shelf life of etched circuit boards that are inventoried prior to assembly and dip soldering, has been developed by Photocircuits Corp., Glen Cove, N. Y. The film is applied after etching the printed circuitry.

The coating is an inexpensive, colorless special plastic film applied thin enough to be hardly perceivable. The film vaporizes upon contact with hot solder and leaves no disagreeable residue or contamination of the solder pot when dip soldering.

## High-Molecular Weight Polyamide

**S**UPPLEMENTING its line of Grilon products (Grilon molding compound for injection molding and extrusion, Grilon monofilaments, and Grilon rods), Holzversuckerungs AG, Zurich, Switzerland, has announced the introduction of a new Grilon compound intended primarily for the extrusion of polyamide sheet, tubing, pipe, and similar profiles, as well as for the manufacture of bottles by the blow-molding process.

Designated as Grilon F-35, this new compound contrasts with currently available polyamide-type resins by having a higher molecular weight.

Grilon F-75 has a degree of polymerization of 600 to 650 compared with a 200 to 400 maximum for other polyamides, according to the pro-

ducer. In addition, the melt viscosity of this high-molecular polyamide is claimed to be considerably above that of other polyamides being currently offered. For example, the general-purpose molding compound Grilon A25G has a melt viscosity of 200 to 3000 poises. The new extrusion Grade F-75 has a melt viscosity of 30,000 poises. Thus, in terms of processing requirements, the new material approaches polyethylene, which has a melt viscosity of about 100,000.

Test production runs have indicated that a melt viscosity of about 30,000 poises is most suitable for presently available extrusion equipment. All extruding machines equipped with nylon worms are suitable for processing the new material. Blow molding and sheet extrusion dies which have been developed for polyethylene can be adapted for use with the Grilon material. The only modifications are those that would be made for general-purpose polyamides.

Polyamide extruded sheet may be deep-drawn and heat-welded. Sheet 0.15 mm. thick and over can also be welded by the high-frequency method. In addition, the high melting point of the material permits heat sterilization of packages as well as the production of containers for medical use which are subjected to wet-sterilization at temperatures up to 130° C. The over-all stability of nylon sheet, furthermore, makes it likely that new fields of application will be found for this material. The water vapor resistance of polyamides is rather high and gas transmission very low.

## New Plant for Parker-Kalon

**M**ODERNIZATION and automation are the key words in any description of the new Parker-Kalon plant in Clifton, N. J.—20 minutes from Times Square. Parker-Kalon, a division of General American Transportation Corp., claims to be the original producer of self-tapping screws widely used as fasteners in the plastics and metals industries. The plant is on a 14-acre site and will employ 1000 persons.

The new building contains 225,000 sq. ft. of floor space but is constructed with knock-out type walls so that the manufacturing area can be readily expanded to 450,000 sq. feet. Raw materials flow from the

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storage area by conveyor through the complete manufacturing process with a minimum of handling. Shipping space has been allotted an area of 40,000 sq. ft. to further help in providing quick service to customers.

## Finishing Compound

**A** NEW finishing methods service is being offered by Atlantic Compound Co., 1860 Baldwin St., Waterbury, Conn., to companies engaged in buffing and polishing. The company will furnish guidance and suggest recommendations on the finishing procedure of specific parts. The information offered will include the proper buff, compound, and wheel speed to secure the type of finish required.

## Butanediol

**P**PRICE of 1,4-butanediol has been reduced from 40 to 33¢ per lb. by General Aniline & Film Corp., 230 Park Ave., New York 17, N. Y. The product is now available on a semi-commercial scale from the company's Linden, N. J., high-pressure acetylene derivatives pilot plant. Further price reductions are anticipated after completion of the new \$6 million plant at Calvert City, Ky. Production is expected to start at the new plant early in 1956.

Now used as a chemical intermediate for plasticizers, polyester resins, polyurethanes, textile auxiliaries, and pharmaceuticals, 1,4-butanediol is also a solvent and humectant.

## Puerto Rican Plastics Plant

**O**PERATION in its new plant in Trujillo Alto, Puerto Rico, has been started by Puerto Rico Industrial Plastics Co., manufacturer of Miraplas wall tile.

The plant, built by Puerto Rico Industrial Development Corp., will produce approximately 10,000 sq. ft. of wall tile a day. The company is an affiliate of Yardley Molded Plastics, Inc., Columbus, Ohio, which is a large manufacturer of plastic pipe under the Clearstream label.

An investment of \$90,000 has been

made for the installation of machinery in the 11,500-sq. ft. plant, which will initially employ 20 persons.

The firm has been in limited operation in Puerto Rico for the past 1½ years, purchasing machine time from West Indies Plastic Co., Rio Piedras, Puerto Rico.

Delbert Haines, formerly purchasing agent of Yardley, is resident manager of Puerto Rico Industrial Plastics. Charles Ebner, vice president of both Puerto Rico Industrial Plastics and Yardley, is working with Mr. Haines in setting up the operations of the new plant. Frederick Hill, Jr. is president of both firms and W. E. Jacobson is general manager and secretary.

## Flooring Division

**F**ORMATION of a Flooring Division has been announced by The General Tire & Rubber Co., Akron, Ohio. Manufacture of Flooring Div. products will be centered at the company's Jeannette, Pa., plant and sales will be directed from Akron headquarters.

J. E. Powers, vice president in charge of plastics, discloses the development of a homogeneous vinyl flooring, called Bolta-Floor. The company plans to market the new product in the moderate- to high-price bracket in 27- and 54-in. rolls and in tiles of ¼- and ⅜-in. and 80-gage thicknesses in all commonly used sizes. The line is being offered in 22 colors.

Robert H. Kilgore has been named manager of the new Flooring Div. He has had eight years experience in plastic film and flooring sales with another firm.

Claiming to be the world's largest producer of plastic film and sheeting, General's plastics operations realized sales of more than \$50 million for the first nine months of its fiscal year.

## Dylite

**T**HE new plant in Willow Grove, Pa., recently acquired by the Sullivan foam Div. of Sullivan Products Co., 214 W. Dauphin St., Philadelphia, Pa., is claimed to be the first such facility in that area devoted to the

design, development, and engineering of products in the new Koppers' Dylite expanded polystyrene.

Occupying 10,000 sq. ft. of manufacturing and office space, the plant will be equipped with special machinery designed for the production of the foam material.

The expandable polystyrene comes as a molding powder which can be molded to any desired shape or color. Polystyrene foam has been used for insulation on tank trucks, refrigerators, ice-making machines, and ice buckets, and for decorative and protective uses in packaging, toys, and buoyant marine equipment.

## Rigid Sheet in Larger Sizes

**A** NEW custom-sizing policy for polyvinyl chloride sheet has been announced by Kaykor Industries, Inc., Yardville, N. J. The company's F-92 unplasticized structural material is now available in sheets 44 in. wide in any length up to a standard maximum of 144 inches. Longer continuous lengths may be obtained on special order. Thicknesses of F-92 structural P.V.C. range from 1/16 to 3/8 inch. Complete specifications are available on request to Kaykor.

## Three New Plaskon Polyesters

**T**HREE new premix Plaskon polyester resins—PE-40, PE-51, and PE-55—especially designed for rapid molding of intricate parts with varying wall thicknesses, difficult contours, and molded-in inserts, have been introduced by Barrett Div., Allied Chemical & Dye Corp., 40 Rector St., New York, N. Y. The economical premix technique is being widely used in the automotive industry where it has enabled reinforced plastics to be produced on a mass production basis.

The resins are premixed by the molder in large batches with filler, pigment, and reinforcing materials. The mixture is then molded in matched metal dies using conventional compression molding presses.

PE-40 is a rigid resin containing diallyl phthalate. It permits fast curing cycles and produces molded parts with outstanding surface characteristics. The material offers high flexural strength and modulus of elasticity, as well as good hot strength.

PE-51, a resilient, high-viscosity resin containing diallyl phthalate, is

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designed specifically for those premix molding applications which require sufficient flexibility to minimize cracking around core pins and inserts.

PE-55 is a resilient resin containing vinyl toluene. It is a medium-viscosity resin available at a lower price than PE-40 and PE-51.

## Polyethylene Tubing

**A** VAILABILITY of its first preliminary extruded samples of Super Aeroflex, the new high-tensile, high-temperature-resistant polyethylene, has been announced by Anchor Plastics Co., Inc., 36-36 Thirty-sixth St., Long Island City 6, N. Y.

The company claims that Super Aeroflex extrusions can withstand higher pressures in tubular form, will not stress-crack, and have better heat resistance than regular polyethylene.

Super Aeroflex is available only in small quantities at the present time. Samples may be obtained gratis from the company.

## PLASTICIZER NEWS

**Secondary Plasticizer**—Manufacture of Kendex 0869X, a low-viscosity, low-cost, secondary vinyl plasticizer derived from aromatic fractions of petroleum, has been announced by Kendall Refining Co., Bradford, Pa.

Kendex 0869X is claimed to be compatible with most commercial primary plasticizers used with vinyl chloride resins. When the plasticizer is substituted for various low-cost secondary plasticizers currently in use, improvement is noted both in initial color and color after ultra-violet exposure, according to Kendall technicians. They also state that if the ratio of Kendex 0869X to total plasticizer does not exceed 30 parts in 100 parts and a proper stabilizer is used, there will be no bleeding.

According to tests made by Kendall, substitution of Kendex 0869X as a secondary plasticizer causes only negligible degradation of physical properties. The color of the finished vinyl is lighter than that obtained when using other commercial

secondary plasticizers evaluated, and the resistance to ultra-violet light is good.

The price of Kendex 0869X in tank-car lots is 3¢ per lb. f.o.b. Bradford, Pa.

**New Flexol Plasticizers**—Now available from Carbide and Carbon Chemicals Co., a Div. of Union Carbide and Carbon Corp., are Flexol plasticizers 810 (a higher alcohol phthalate) and 10-10 (didecyl phthalate) compounded with an anti-oxidant. These plasticizers with the added anti-oxidant are designated Flexol plasticizer 810x and Flexol plasticizer 10-10x.

Addition of an anti-oxidant improves the heat aging properties of 810 and 10-10 in vinyl compounds designed for high-temperature use, such as vinyl electrical insulation compounds.

No premium is charged for the addition of the anti-oxidant. Prices are as follows: tank-car lots, 30.5¢ a lb.; carload lots of drums, 32.5¢ a lb.; and less than carload lots of drums, 33.5¢ a pound.

Tank-car quantities of Flexol plasticizer 10-A (didecyl adipate) are also available from Carbide. Decyl alcohols used in the production of this new plasticizer are produced in Carbide's new Oxo unit at Texas City, Texas.

Reduced volatility and improved resistance to water extraction are outstanding features of 10-A, along with its ability to impart excellent low-temperature flexibility and light stability to vinyls. Plastisols prepared with 10-A have superior viscosity stability.

Prices of Flexol 10-A are: 42.5¢ a lb. in tank-car quantities; 44.5¢ a lb. in carload lots of drums; and 45.5¢ a lb. in less than carload lots of drums. All prices are f.o.b. delivery point of rail carrier in the United States.

**Ohio-Apex Plasticizer**—Di-isodecyl phthalate plasticizer is now commercially available from Ohio-Apex Div., Food Machinery & Chemical Corp., Nitro, W. Va. The company has been producing di-iso-

decyl phthalate experimentally for some time and its technicians believe it will become one of the important plasticizers of the future.

Ohio-Apex officials state that they have started production of this plasticizer in unlimited quantities because of its low price and because they are convinced that it is one of the most permanent phthalate plasticizers available for use in vinyl compounds. In standard tests it shows less volatile loss than many other plasticizers; in aging tests it has proved exceptionally successful in retention of low-temperature properties.

Di-isodecyl phthalate is a primary plasticizer for most resins and imparts permanent flexibility, good low-temperature flexibility, heat and light stability, low migration, low water extraction, and very good hand and drape.

**Stabilizing Plasticizer**—Pilot plant quantities of a new stabilizing plasticizer of the epoxy type are now available from Baker Castor Oil Co., 120 Broadway, New York 5, N. Y. The new product is distinguished from ordinary epoxidized oils by marked solubility in alcohols, higher viscosity, and greater resistance to gasolines, aliphatic solvents, and oils due to an acetoxymodification of its structure.

Designated as Estynox 308, the plasticizer stabilizes such polymers as nitrocellulose, cellulose acetate butyrate, polyvinyl chloride, and chlorinated and synthetic rubbers against heat and ultra-violet light.

**Continental Oil's Plasticizer**—Development of Conoco H-340, a new secondary plasticizer with good color and odor characteristics has been announced by Continental Oil Co.'s Petrochemical Dept., 630 Fifth Ave., New York, N. Y. The plasticizer, which is said to be economical and easy to handle, is an almost water-white liquid with a specific gravity of 0.865 and a viscosity of 19.9 cp. at 100° F.

When used in conjunction with dioctyl phthalate, Conoco H-340 is claimed to exhibit superior heat and light stability, improved low-temperature flexibility, and equivalent tensile and hardness characteristics. It excels as a viscosity depressant when used in plastisol or organosol formulations, and its wetting prop-

erties make it an excellent dispersing medium for pigments.

Continental's executive headquarters are in Houston, Texas, P. O. Box 2197.

## EXPANSION

**The Borden Co.'s Chemical Div.** will double its West Coast output of formaldehyde by building a new plant in the Seattle, Wash., area. The plant, to be geared to produce more than 36 million lb. of formaldehyde a year, is scheduled for completion late in 1956. This is Borden's second northwest formaldehyde facility—the other is at Springfield, Ore. The company claims the sale of 10% of all the formaldehyde used in the United States.

The new plant will be under the direction of **Ray T. Hanson**, West Coast general manager of the Chemical Div. Mr. Hanson also manages the present Borden plant in Seattle which produces dry adhesives for plywood; the Springfield plant which manufactures formaldehyde and liquid resin for plywood, hardboard, and chip-core operations; and the Los Angeles plant which produces industrial adhesives and P.V.A. emulsions for adhesives and paints.

**Pennsylvania Salt Mfg. Co.**, 3 Penn Center Plaza, Philadelphia 2, Pa., has started construction of a large organic fluorine chemicals plant at Calvert City, Ky. The new unit will become a major component of Pennsalt's closely integrated chlorine-fluorine production facilities on the Tennessee River. Full-scale operations are expected to begin some time in 1956.

Initial products from the new facility will serve the growing refrigerant and aerosol-propellant fields. Future products from this plant and related facilities at the same location are expected to find uses in new and improved plastics, lubricants, metal fluxes, anesthetics, ceramics, agricultural chemicals, and new applications in the growing field of atomic energy.

**Farrell-Birmingham Co., Inc.**, Ansonia, Conn., has purchased the Press Div. of The Watson-Stillman Co., Div. of H. K. Porter Co., Inc., Roselle, N. J. The purchase included engineering and sales divisions, patents, drawings, jigs, and fixtures for all Watson-Stillman presses but did

not include that portion of the plant at Roselle where Watson-Stillman will continue the manufacture of other products.

Both companies have long served the plastics industry. Farrell-Birmingham, with plants at Ansonia and Derby, Conn., Buffalo and Rochester, N. Y., manufactures calenders, large size extruders, Banburys, and other compounding equipment. Watson-Stillman is a pioneer producer of injection molding machines. Farrell-Birmingham plans to continue the engineering and sales activity at Roselle. The manufacture of presses at Roselle ceased after December 30, 1955 and will be continued hereafter in Farrell-Birmingham plants.

**Phillips Chemical Co.** announces that a new sales service laboratory is under construction adjacent to the Chemical Research Laboratories being built by its parent company, Phillips Petroleum Co., at the Phillips Research Center, Bartlesville, Okla. The structure will provide space for a wide variety of services and facilities required as a result of Phillips' development of its new thermoplastic material, Marlex 50.

The new sales service laboratory will have the latest equipment for evaluating, converting, and fabricating plastics, especially Phillips' new family of Marlex olefin polymers. A resident staff of engineers is now preparing for customer service, development and proving of new uses for Marlex polymers, and product evaluation.

In addition to service engineers' offices and conference space, the laboratory will have complete facilities for physical, chemical, and electrical testing, as well as extensive molding, extrusion, and converting equipment, so that any field of plastics, such as film, fiber, pipe, wire and cable, structural, and other applications, may be demonstrated on a basis typical of commercial production.

**Rohm & Haas Co.**, Philadelphia 5, Pa., has purchased 4½ acres of land in Miles, Ill., near the Chicago city limits, as a site for a warehouse and office building which is expected to be ready for occupancy before the end of 1956.

A part of the company's history centers in the Chicago area and about 40 persons are now employed in the present Chicago sales office

and rented warehouses under the supervision of **T. L. Dorrian**. Products to be warehoused include agricultural and sanitary chemicals, leather chemicals, plastics molding materials, and synthetic resins used in the manufacture of paints and industrial coatings.

**Lustro Tile Products Corp.**, 1066 Home Ave., Akron 10, Ohio, producer of plastic wall tile, has expanded its facilities to include a new plant and modern equipment.

Now available from Lustro is a new line of polystyrene wall tile, called Deluxe Crown Contour. This addition rounds out Lustro's present line of Lustr-O-Lite, Pearlite, Royal Dresden, and Vitro-Plas, and gives the company a complete price range. A selection of 47 colors and more than 1000 tile and trim pieces are being offered.

**E. H. Titchener & Co.**, manufacturer of welded and wire assemblies, has added new installations to its plant facilities in Binghamton, N. Y., which include an electropolishing process for finishing stainless steel wire forms and assemblies and a plastisol dip operation for black or white coating of wire assemblies, such as chair backs, hospital equipment, leather working racks, and holding devices for glass and ceramics.

**International Research Associates, a Division of International Processes, Inc.**, has opened an office in Milan, Italy. The firm established a Genoa office in 1950.

The new Milan office will exclusively represent United States' manufacturers of plastics materials and supplies, products, and equipment. At present, negotiations are under way to have a plastic exhibit for clients in several European industrial fairs, including the 1956 Milan Fair. The recent Milan Fair had over 4 million visitors and 89,723 buyers.

**The Glastic Corp.** has opened a new building at 4321 Glenridge Rd., Cleveland 21, Ohio, which increases the firm's space and facilities 50 percent. Incorporated in the new structure are modern features of plant design and construction which speed the manufacture of sheet, molded, and extruded glass-reinforced polyester products, as well as larger compression molding presses. The company states that production ca-

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capacity for electrical sheet and electrical rod stock have been doubled. The acquisition of 11 acres provides for further growth.

**Portco Corp.'s Paper and Plastic Div.**, Vancouver, Wash., has acquired machinery and equipment of Central States Paper & Bag Co.'s operation at Auburn, Wash., which have been transferred to the enlarged Portco plant at Vancouver. The company designs and fabricates a line of standard and custom-tailored bags, covers, and liners for industrial and agricultural products and produces a wide assortment of specialty paper twines.

New products added to Portco's production, as a result of the installation of modern, versatile machinery, include polyethylene bags, covers, liners, and sheets in a full range of thicknesses and sizes, waxed and treated papers, and spiral-wound tubing custom tailored to meet specific requirements.

New construction, completed last October, added 50,000 sq. ft. of manufacturing area to the plant located on 16 acres of land bordering the Columbia River.

**Durethane Corp.**, Chicago, Ill., announces that in less than three years, the company has completely outgrown a good-sized plant built especially for the production of polyethylene film. Even the erection of a second large, modern plant in Los Angeles two years ago hasn't stemmed the tide.

Accordingly, Durethane has recently broken ground for a new Chicago plant on a 5-acre plot at 7001 W. 60th St., Chicago, which it expects to occupy by April. The new facility has been designed to accommodate a large installation of new equipment. In addition to the production area, the building will contain extensive laboratory facilities and sales and executive offices.

## COMPANY NOTES

**American Cyanamid Co.**, 30 Rockefeller Plaza, New York 20, N. Y., announces the following appointments in its Plastics and Resins

Div.: **G. W. Larson** has been named supervisor of plastics promotion. For the past eight years, Mr. Larson has served as manager of technical service for Jefferson Chemical Co., a Cyanamid subsidiary. **E. V. Michal** has been appointed supervisor of thermosetting products. He joined the company in 1936, serving in the Molding Engineering Dept. at the Bound Brook, N. J., plant for three years prior to a 15-year span as a technical service representative. **Joseph Grabowski** has been named supervisor of thermoplastic products. He was a technical service representative for the past nine years. From 1937 to 1946, Mr. Grabowski was engaged in plastic development work in Cyanamid's Stamford Research Laboratories. **Arthur Nufer** has been made senior technical sales representative for thermoplastic compounds. He was formerly associated with Tech-Art Plastics Co. as supervisor of production engineering and with Bakelite Co.

The company also announces that **S. L. Duff** has been appointed a sales representative for its Pigments Div., working with **Peter Kovol** out of Cyanamid's St. Louis, Mo., office.

**Hercules Powder Co., Inc.**, Wilmington 99, Del., announces that **Dr. Robert W. Cairns**, formerly assistant director of the Research Dept., is now director of research. He succeeds Dr. Emil Ott who resigned to join Food Machinery & Chemical Corp. Dr. Cairns joined the company in 1934 as a research chemist at Hercules' Experiment Station.

**The Borden Co.'s Chemical Div.** has established a new service laboratory in Los Angeles, Calif., for the water-based paints and adhesives industries. **Harold L. McKinsey**, formerly with Borden's chemical laboratories in Peabody, Mass., will direct the new laboratory.

**General Electric Co.**, Pittsfield, Mass., announces the following appointments in its Phenolic Products Section: **James F. Whitney**, who has been with the company since 1939, has been named superintendent of

the phenolic products plant; **Anthony G. Polidoro** has been appointed purchasing agent; **Boyette Edwards** has been named specialist of operations research projects; and **Kenneth L. Laut** has been appointed supervisor of manufacturing at G-E's varnish plant in Coshocton, Ohio. The four appointees will report directly to **J. L. Galt**, plant manager.

G-E also announces that Dr. **George A. Cypher** has been named specialist of insulating materials for its Chemical Materials Dept. in Schenectady, N. Y. Dr. Cypher was promoted to the Schenectady post after five years service at G-E's Thomson Laboratory in Lynn, Mass.

**Union Carbide International Co.**, a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y., announces that **Clinton P. Carhart**, former product manager of the Plastics Dept., has been named assistant manager of chemical and plastic sales. **Arthur K. Myers**, formerly manager of the Plastics Div., Union Carbide Europa, S.A., Geneva, Switzerland, has been transferred to New York and becomes product manager of the Plastics Dept.

**Nopco Chemical Co.**, Harrison N. J., announces that **George C. Stier** has been elected vice president of the company and will be in charge of the Plastics Div. He will be responsible for the expansion program started by Nopco in the field of rigid and flexible foamed plastics. **Dr. Charles A. Fetscher** has been named director of the Industrial General Laboratory. Dr. Fetscher will be in charge of research activities pertaining to the development of new products.

**Dewey and Almy Chemical Co.**, Div. of W. R. Grace & Co., 62 Whittemore Ave., Cambridge 40, Mass., has assigned **Charles N. Neunhoffer** and **William A. Morton** to its organic chemicals sales staff. Mr. Neunhoffer will cover the central midwestern states; Mr. Morton's territory will include the southern states. Both appointees will report to **John Broughton**, midwestern regional sales manager, at 100 W. Monroe St., Chicago 3, Ill.

**The Polymer Corp. of Pennsylvania**, Reading, Pa., has appointed the following distributors to handle its

full line of industrial non-metallics, including Polypenco nylon, Teflon, and specialty plastic materials: **Bearings, Inc.**, Cleveland, Ohio, and Indianapolis, Ind., **Dixie Bearing Co.**, Atlanta, Ga., a subsidiary of Bearings, and **Delta Products, Div. of Air Accessories, Inc.**, Fort Worth, Texas, will cover their various neighboring territories.

**Eastman Chemical Products, Inc.**, 260 Madison Ave., New York, N. Y., announces that the new locations of its Dayton, Ohio, and Houston, Texas, sales offices are at 2600 Far Hills Ave., Dayton, and 704 Texas National Bank Bldg., Houston. The Dayton office handles sales for Eastman Tenite plastics and the Houston sales office handles both Tenite plastics and Eastman industrial chemicals.

**The Dow Chemical Co.**, Midland, Mich., announces that **Floyd J. Gunn**, formerly manager of coating sales for the Plastics Div., has been made manager of the company's Los Angeles, Calif., office. Mr. Gunn succeeds **Homer L. White** who has taken over an assignment on the company's production control staff in Midland. **W. L. Nelson**, who has headed the sale of saran wrap for household packaging since 1952, will assume over-all responsibility for the sale of commercial applications of saran wrap and other Dow plastic films. **L. E. Fake** has been appointed to Mr. Nelson's staff to take charge of sales.

**Barrett Div., Allied Chemical & Dye Corp.**, 40 Rector St., New York 6, N. Y., reports that **Ralph W. Burdeshaw** has been appointed southern district manager of industrial resins sales. Mr. Burdeshaw will reside in Greensboro, N. C. **Theodore R. von Toerne** has been named a mechanical engineer and technical service representative at Barrett's Shadyside Research Laboratory in Edgewater, N. J. Mr. von Toerne was formerly plant manager of Keystone Plastics, Inc.

**A. Bamberger Corp.**, 703 Bedford Ave., Brooklyn 6, N. Y., announces that **Edward J. Sheridan** has been elected vice president in charge of production for the company and its subsidiary, **American Molding Powder & Chemical Co.** Mr. Sheridan was formerly affiliated with Interchemical Corp.'s R-B-H Div. as

chief chemist and with Sun Chemical Corp.'s Pigments Div. as general manager. **Seymour Lewis**, formerly production manager, has been promoted to technical director in charge of research, development, and engineering. Mr. Lewis' previous associations were with Clopay Corp. and Irvington Varnish & Insulator Corp. **Joseph Foier** succeeds Mr. Lewis as production manager.

**Bakelite Co.**, a Div. of **Union Carbide and Carbon Corp.**, 30 E. 42nd St., New York 17, N. Y., announces the following appointments: **William J. Canavan** has been named assistant manager of the Extrusion Materials Div. **Richard H. Bruce**, formerly Eastern Zone manager of the Molding Materials Div., is now manager of the division. **J. R. Wilkinson** succeeds Mr. Bruce as Eastern Zone manager. **D. A. Munns** has been assigned to the Market Development Group and will be responsible for the promotion of standard polystyrene base products.

**Olin Mathieson Chemical Corp.**, 460 Park Ave., New York 22, N. Y., announces that **Edward A. Johnson** has been appointed film engineer and **Robert D. Elkund** midwest sales representative for its Olin Film Div. **Smith Conklin** has been named maintenance supervisor of the cellophane plant currently under construction. The plant, which is scheduled to open mid-1956, is being built at Olin, Ind., two miles west of Covington, by Ecusta Paper Corp., a subsidiary of Olin Mathieson. Mr. Conklin has been with Ecusta as methods and standards engineer in its cellophane plant since 1952.

**Wheelco Instruments Div., Barber-Colman Co.**, Rockford, Ill., has appointed **Grant Edgel Co.**, 8714 N.E. Siskiyou St., Portland 20, Ore., as its representative in the Portland area. The Seattle, Wash., territory is being served by Wheelco's branch office at 9590 N.E. 24th St., Bellevue, Wash. **Ray E. Brainard** is in charge of the office.

**Stillman Rubber Co.**, Culver City, Calif., announces that **C. T. Erickson**, formerly sales manager, has been elected executive vice president of the company.

The company also announces that **The Greene Rubber Co.**, Broadway at Sixth St., Cambridge, Mass., and **Manufactured Rubber Products Co.**,

401 W. Somerset St., Philadelphia, Pa., have been named distributors of Stillman products. In addition to the manufacture of rubber products, Stillman produces silicone and Teflon finished products.

**Chas. Pfizer & Co., Inc.**, 630 Flushing Ave., Brooklyn 6, N. Y., announces that **Paul E. Weber** has been named sales manager of the company's Chemical Sales Div. He succeeds Frank F. Black who has resigned. Mr. Weber has been with the company since 1938. **H. Chandler Smith**, former eastern regional manager, has been appointed assistant to Mr. Weber.

**National Carbide Co.**, a Div. of **Air Reduction Co.**, 60 E. 42nd St., New York 17, N. Y., announces that **George R. Milne**, formerly vice president of operations, has been named president of National Carbide, succeeding the late J. Carl Bode. **Russell T. Lund** succeeds Mr. Milne as vice president of operations. Mr. Milne's headquarters will be in New York City and Mr. Lund will remain at the Calvert City, Ky., plant.

**Skeist Laboratories** has opened a new laboratory at 89 Lincoln Park, Newark, N. J. Directed by **Dr. Irving Skeist**, the company specializes in product, process, and market research on polymers, plasticizers, adhesives, resins, and coatings.

**Como Plastics, Inc.** (formerly known as Columbus Molded Plastics Corp.), 1703 Keller Ave., Columbus, Ind., has appointed **Associated Engineers, Inc.**, 748 E. Wayne St., Fort Wayne, Ind., as its sales representative in Columbus, Ind., southern Michigan, western Ohio, and northern Kentucky.

**Monsanto Chemical Co.'s Plastics Div.**, Springfield, Mass., announces the promotions of **Edmond S. Bauer** to assistant director of sales for resin products and **Thomas W. Sears** to sales manager for industrial resins.

**F. J. Stokes Machine Co., Inc.**, 5500 Tabor Rd., Philadelphia 20, Pa., announces that **Samuel H. Greenwood** has been named field sales manager; **Fred Hillsley** succeeds Mr. Greenwood as district manager of the Philadelphia territory.

**National Rubber Machinery Co.** has opened offices at 1516 N. Harlem Ave., River Forest (suburb of



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Chicago), Ill., to increase its sales engineering service in the midwest. **William G. Potts** has been appointed district manager of the new office.

**Sam Chinkes Associates**, industrial designers, are now located at 95 Park Terrace East, New York 34, N. Y.

**J. P. Stevens & Co., Inc.**, Broadway at 41st St., New York 36, N. Y., announces that **J. P. Schwebel** and **Irwin J. Gusman** have joined the company and will be in charge of the merchandising and sales of industrial fibrous glass fabrics.

**National Research Corp.**, Newton, Mass., announces that **Sherwood G. Burnett** has been appointed manager of the Process Equipment Section of the company's Equipment Div. Mr. Burnett was formerly New England district manager of Naresco Equipment Corp., sales subsidiary of National Research. **Theodore E. Burleigh, Jr.** succeeds Mr. Burnett as New England district manager.

**Riegel Paper Corp.**, 260 Madison Ave., New York 16, N. Y., announces that **John L. Riegel** was elected president of the corporation. He succeeds Walker Hamilton, who has retired after 34 years' service with the firm. **Frederick S. Leinbach** and **G. Lamont Bidwell, Jr.** were elected vice presidents. Mr. Leinbach will continue as assistant general sales manager and Mr. Bidwell as Milford Mill manager.

**Shoe Form Co., Inc.**, Auburn, N. Y., manufacturer of plastic utility boxes and shoe and hosiery forms, has moved its sales office to 303 Fifth Ave., New York 16, N. Y. **Don Geary** is New York representative for the company.

**Escambia Bay Chemical Corp.**, Shreveport, La., announces that **Nat C. Robertson** of Boston has been appointed director of research. Dr. Robertson will make his headquarters temporarily with National Research Corp., Cambridge, Mass., where he has been director of the Petrochemical Dept. for several years. He will continue to direct research activities already under way for the chemical company at that

location. **D. J. Stark** has been named plant manager of Escambia. He was formerly manager of the National Petrochemicals Corp. plant at Tuscola, Ill.

#### Corrections

In the Plastiscope section of the December issue, mention was made that Plastic Art Decorating Co. was the new name of **Modern Art Printing Co., Inc.** Modern Art Printing Co., Inc., is still operating at 34-36 Fifty-sixth St., Woodside 77, N. Y., under the direction of **Percy Rimes**.

Our attention has been called to the fact that two metallizers listed in a panel accompanying the article, "Mighty Beauty," on page 88 of the November issue of **MODERN PLASTICS**, have been merged into **Continental Can Co., Metallized Materials Div.**, 100 E. 42nd St., New York, N. Y. The companies are **Shellmar-Betner Div.**, **Continental Can Co.**, and **Vaporized Metal Coatings**.

#### PERSONAL

**Dr. Edgar C. Britton**, director of the Edgar C. Britton Research Laboratory of **The Dow Chemical Co.**, Midland, Mich., and past president of the American Chemical Society, has been chosen to receive the highest award in American industrial chemistry, the Perkin Medal of the American Section, Society of Chemical Industry, for 1956.

**Dr. Britton's** early work on the production of synthetic phenol (carbolic acid) made this vital raw material abundantly available for a large segment of today's plastics industry. Derivatives of phenol also are used in such products as weed killers, insecticides, fungicides, and preservatives. **Dr. Britton** also pioneered the commercial development of silicone resins.

**Frederick W. Mellor, Jr.** has been appointed to the newly created post of manager of laminated products sales of **Goodyear Aircraft Corp.**, Akron, Ohio. The company intends to increase its activity in the sale of reinforced plastics products to commercial markets, particularly in the automotive, farm implement, and allied industries. During the past 18 months, **Mr. Mellor** has devoted the majority of his time to the development of new business to match the company's production potential,



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augmented considerably a year ago with the installation of a heavy bank of 100- and 700-ton presses for mass production.

**T. R. Miller** has been named director of development of **Carbide and Carbon Chemicals Co.**, a Div. of **Union Carbide and Carbon Corp.**, 30 E. 42nd St., New York 17, N. Y.

**Thomas C. Fogarty** has been elected president of **Continental Can Co.**, to succeed **Hans A. Eggers**, retired.

**Olin D. Blessing** has been appointed a vice president of **Dow Corning Corp.**, Midland, Mich. He started with the company in 1943 with a two-man sales department and one customer, the U. S. Government. Sales volume then was \$1 million; it is now over \$25 million with 100 technically trained men selling over 200 commercial silicone products to thousands of customers in every major industrial market.

**Henry H. Reichhold**, head of **Reichhold Chemicals, Inc.**, White Plains, N. Y., has resigned from the board of directors of **Catalin Corp.** of America. Mr. Reichhold states that his resignation was prompted by the fact that **Catalin** and his company were unable to arrive at a satisfactory basis of merger.

**William E. Stubbins** has been appointed New England representative for **Van Vlaanderen Machine Co.**, Paterson, N. J., producer of calendaring and processing equipment for the plastics industry. Mr. Stubbins' headquarters will be at 211 W. Exchange St., Providence, R. I.

**Dr. J. R. Dudley** has been named director of research and development of **The Richardson Co.**, Melrose Park, Ill. Dr. Dudley was formerly vice president and director of research and development of **The Carwin Co.**, New Haven, Conn.

**Herbert B. Weinman** has been appointed divisional chief sales engineer of **Victory Mfg. Co.**, 1720 W. Arcade Place, Chicago 12, Ill., plastics molder. A 12-year veteran in the plastics industry and tool and die design, Mr. Weinman specializes in

the design of injection molds and will service Victory customers in Indiana and Ohio. He comes to Victory after five years with **Amos Molded Plastics**, Edinburg, Ind.

**Donald A. Voorhees** has been elected vice president and general manager of **The Sierracin Corp.**, 1121 Isabel St., Burbank, Calif. The company manufactures **Sierracin 611**, transparent aircraft glazing material for aircraft canopies and windows. Mr. Voorhees was formerly associated with **Booz, Allen & Hamilton**, management consultants.

**Donald W. Hill**, vice president of **Crown Cork & Seal Co., Inc.**, Baltimore, Md., and general manager of the company's Specialty Div. in St. Louis, Mo., has been promoted to vice president and general manager of the **Crown and Closure Div.** Mr. Hill will make his headquarters in Baltimore.

**William J. Woodruff** has been appointed sales manager of **Tech-Art Plastics Co.**, Morristown, N. J. The company, founded in 1891, is engaged in custom plastics molding. Mr. Woodruff was formerly general manager of **T. M. James Co.**, Newark, N. J., a division of **The Stewart Hartshorn Co.**

**Henry Thompson** has been named sales manager of **Ra-Vac, Inc.**, High Bridge, N. J., successor to **Industrial Radiant Heat Corp.**, Gladstone, N. J. Mr. Thompson was formerly an official of **Triangle Finishing Corp.**, Johnstown, N. J.

The company has established new offices at 114-16 Twenty-sixth St., New York, N. Y., for the metropolitan trade. Mr. Thompson's activities will primarily be in High Bridge.

**David R. Lurie** has joined **Joclin Mfg. Co.**, 9 Phillip Place, North Haven, Conn., as sales manager. The company molds and fabricates **Teflon**, **Kel-F**, and **silicones**. Mr. Lurie was formerly district sales manager of **Barrett Div.**, **Allied Chemical & Dye Corp.**

**James J. Plzak** has been appointed special project sales representative for **Consoweld Corp.**, Wisconsin

Rapids, Wis. He will handle special accounts in industrial, commercial, and institutional sales fields. When **Consoweld** was organized in 1942, Mr. Plzak headed war contract sales and since 1946 has worked in the decorative panel sales field.

**Carl A. Raabe** has been elected president and director of **Durethene Corp.**, 1859 S. 55th Ave., Chicago, Ill. Mr. Raabe was for 17 years general manager of **American Phenolic Corp.**'s Cable and Synthetics Div.

**Norman L. Cooperman** has been appointed by **National Lead Co.**, 111 Broadway, New York 6, N. Y., to head up the company's technical service in the sale of plasticizers and stabilizers for the vinyl resin industry.

**John P. Slattery** has been appointed sales manager of **Pacific Plasti-Fab Corp.**, San Carlos, Calif. He was formerly market research director and account executive of **Foote, Cone & Belding Advertising**.

**James F. Adams** is now director of purchases of **Plumb Chemical Corp.**, Philadelphia, Pa., manufacturer of **Fibercore** molding compounds. Mr. Adams formerly served in administrative and sales capacities with **Fayette R. Plumb, Inc.**, the parent company.

**Harry S. Collins** has been appointed general sales manager of **Metallizing Co. of America**, Chicago, Ill. The general sales office is located at 431 E. 75th St., New York 21, N. Y. Mr. Collins was formerly connected with **Metallizing Engineering Co.**, Westbury, N. Y., for 15 years.

**George C. Sweet** has been named director of purchases of **Reichhold Chemicals, Inc.**, White Plains, N. Y. He joined the company in 1947 and has been central purchasing agent of **Reichhold** for the past two years.

**William R. Hartman** has been named technical superintendent of **Laurie Rubber Reclaiming Co.**, East Millstone, N. J., replacing **Clarence B. Clark** who has retired after 41 years of service with the company. **Laurie Rubber** custom mixes rubber and plastic compounds.

**Donald A. McQuarrie**, '58 of Lowell, enrolled in the plastics engineering course at **Lowell Technological Institute**, Lowell, Mass., has

been awarded the first scholarship for plastics study established by the **Society of Plastics Engineers, Inc.** He received a check for \$200 from Harry Connors of Boston, president of the Eastern New England Section of S.P.E., at a recent ceremony.

## MEETINGS

### Plastics Groups

**Jan. 18-20**—Society of Plastics Engineers, Inc., Twelfth Annual National Technical Conference, Statler Hotel, Cleveland, Ohio.

**Feb. 7-9**—The Society of the Plastics Industry, Inc., Eleventh Annual S.P.I. Reinforced Plastics Division Conference, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.

**March 8-9**—The Society of the Plastics Industry Canada, Inc., Fourteenth Annual S.P.I. Canadian Conference, Sheraton-Brock Hotel, Niagara Falls, Ontario, Canada.

**March 27**—The Society of the Plastics Industry, Inc., Pacific Coast Section, Annual Meeting, San Francisco, Calif. Other meetings aboard ship, March 28 to April 2.

**June 11-15**—The Society of the Plastics Industry, Inc., Seventh National Plastics Exposition, New Coliseum, New York, N. Y.

### Other Meetings

**Feb. 26-29**—American Institute of Chemical Engineers, Hotel Statler, Los Angeles, Calif.

**Feb. 27-March 2**—American Society for Testing Materials, National Meeting, Hotel Statler, Buffalo, N. Y.

**March 5-7**—Packaging Association of Canada, National Packaging Convention, King Edward Hotel, Toronto, Ont.

**March 19-23**—American Society of Tool Engineers, Annual Industrial Exposition, International Amphitheatre, Chicago, Ill.

**April 3-9**—Commission on Macromolecules of the International Union of Pure and Applied Chemistry and The Weizmann Institute of Science, Rehovot, Israel. Subjects include: "General Behavior of Polymers in Solution," "General Behavior of Biocolloids and Polyelectrolytes in Aqueous Solution," and "Special Polymeric Systems in Solution."

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## MACHINERY and EQUIPMENT FOR SALE

FOR SALE: (11) 75 ton record presses, complete @ \$2,450. (11) new 100 ton, 16" ram, 14" stroke @ \$1,100. (8) 200 ton, 9" stroke, 14" ram, 36x36 @ \$1,550. (7) 200 ton, 9" stroke, 15" ram, 36x36 @ \$1,450. (1) 50 ton complete, 15x15 @ \$1,850. (1) 200 ton, 16" ram, 36x36 @ \$2,450. (3) 200 ton, 16" ram, 42x42 @ \$2,650. (1) 200 ton, 15" ram, 42x42 @ \$2,450. (4) 250 ton, (2) 13" rams, 36x40 rebuilt @ \$3,375. HYDRAULIC SAL-PRESS CO., INC., 388 Warren Street, B'klyn, N. Y.

FOR SALE: 1—Royle #4 Extruder, motor driven; 1—6"x12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size 0 m.d.; 2—Baker-Perkins Size 15, 100 gal. Jacketed Mixers; 5—Horizontal Dry Powder Ribbon Mixers, 4000 #, 1500 #, 500 #; 1—New 3 Roll 6"x18" Laboratory Calendar; 1—Farrell-Birmingham 60" Mill with reduction drive, 150 HP motor, floor level mounting; 1—Fitzpatrick "D" Comminutor, S.S. contact parts, jacketed; 1—Mikro Pulverizer #2th, with motor; 4—Reed Prentice & W.S. Injection Molding Machines, 2-18 oz.; Also other sizes: Hydraulic Presses, Yarnbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N.J. HOboken 2-4425, N.Y. Tel: BArlay 7-6660.

FOR SALE: Injection Molding Machines, 16 oz. H.P.M. Late type machines, 9 oz. H.P.M., 8 oz. W. & S., 4 oz. De Mattia, Mod. 252 Stokes closure press, Ball & Jewell plastic grinders. AARON MACHINERY CO., INC., 45 Crosby Street, New York 13, N. Y.

FOR SALE: 3—Ball & Jewell #2, #1 1/2 Rotary Cutters; 1—Cumberland #0 Rotary Cutter; 4—Two Roll Mills 30"x32"x40", 15"x40", 6"x14"; 3—Baker Perkins 100 gal. 50 gal., 2 gal., jacketed double arm Mixers; 1—Stokes Rotary Preform Press #DD82 NEW; 3—Stokes Model "R" single punch Preform Presses NEW; 1—Kux Model 15-25 Rotary Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; BRILL EQUIPMENT CO., 3497 Third Ave., New York 51, N. Y.

FOR SALE: 1 National Erie 8 1/2" strainers; 2—800 ton self-contained compression molding presses; 1 R D Wood 30 ton self-contained molding press; 2 Farrell 12"x24" plastics mills; 1 NRM 1" electric extruder; also mills, mixers, choppers, etc. CHEMICAL & PROCESS MACH. CORP., 53 Ninth Street, Brooklyn, N. Y.

BANBURY Size B Lab Mixer, Thropp 3"x8" Lab Mill, Stokes 150 ton semi-auton. hydr. Press, Kux 2 1/2" dia. single punch Preform Machine, Leominster 8 oz. Injection Molding Machine, Farrell 15"x36" 3 roll Mill, Mills and Calenders up to 84", New Sero 6"x12" and 6"x18" Lab. Mixing Mills and Calenders, Plastic & Rubber Extruders, Brunswick 225 ton, 21"x21" platens, French Oil 8 opening 315 ton, 42"x42", Wat.-Stillman 75 ton automatic Molding Press 20"x30" platens, 200 ton Hobbing Press 18"x14" platens, HPM 200 ton 30"x18" platens, New Loomis 340 ton, 24"x56" platens, Robertson 150 ton, 24"x24" platens, Adams 100 ton, 20"x20" platens, Farrell 200 ton, 20"x50" platens, Southwark 30 ton 14"x14" platens, semi-auto. Also Lab to 2000 tons from 12"x12" to 48"x48", Hydr. Oil Pumps, Gould 75 HP motor Dr. 2 stage Centrif. Pump 250 #, W.S. 4 Plaz. High and Low Pressure Hydr. Pump, Elmes Hor. 4 Plaz. 4500 lbs. and 5500 lbs. Hydr. Pumps, Accumulators, Stokes Automatic Molding Presses, Rotary & single Punch Preform Machines 1/2 to 4", Injection Molding Machines 1 oz. to 60 oz. Baker Perkins Jacketed Mixers, Plastic Grinders, Heavy duty mixers, gas boilers, Partial listing. We buy your surplus machinery. STEIN EQUIPMENT CO., 187 8th Street, Brooklyn 15, N. Y. STerling 8-1944.

FOR SALE: (2) 200 Ton W.S. Presses 20x20 & 24x24 Platens, 140 Ton W.S. 22x16 Platen, 85 Ton Waterbury Farrel 28x24 Platen, 63 Ton Press 15x15 Platen with Fullback Cyls. 9, 8, 4, 0z. Injection Molding Machines, 15 Ton Lab. Presses 10x8 Platen, 10 Ton Lab. Presses 6x6 Platen Ball & Jewell Plastic Grinders, Standard Mystic Embossing Presses, Accumulators, Pumps, Valves, No. 252 Stokes Closure Press, 250 Ton W&S 28x24 Platens, 80 Ton Farrel 24x24 Platens. Many other Presses—Send for Bulletin. AARON MACHINERY CO., INC., 45 Crosby St., New York 13, N.Y. Tel.: Walker 5-8300.

SAVE WITH GUARANTEED REBUILT EQUIPMENT: HYDRAULIC PRESSES: Compression Molding Dunning & Bouchert 2-12" ram 170 tons; 2-10" ram 118 tons; Wood 28"x30" 170 tons; Southwark 24"x24" 170 tons; Baldwin Southwark 4-28"x28" 9" ram 75 tons; 5-28"x28" 7" ram 57.7 tons; 5-15"x15" 8" ram 75 tons; 4-14"x14" 8" ram 75 tons; 2-19"x24" 10" ram 78 tons; 18"x18" 7" ram 57.7 tons; 3-12"x12" 7 1/2" ram 46 tons; 8"x9" 4 1/2" ram 24 tons, D&B 12"x12" 3" ram 10 tons; Transfer Molding 75 tons; Preform Presses 5 1/2 T Colton and Stokes R. M.D.; NEW UNIVERSAL DUAL PUMPING UNITS, 3-15 HP; NEW LABORATORY MILLS and CALENDERS, also extruders, mixers, vulcanizers, injection molding units, etc. UNIVERSAL HYDRAULIC MACHINERY CO. INC., 285 Hudson Street, New York 13, N. Y.

AVAILABLE AT BARGAIN PRICES: Mits & Merrill 15 CD Rotary Cutter, J. H. Day, from 1/4 up to 100 gal. Imperial and Cincinnati D. A. Jacketed, Sigma Blade Mixers, Day 15 to 10,000 lbs. Dry Powder Mixers, Baker Perkins Heavy Duty (Steam Jacketed) Double Arm, from 5 to 200 gal., Mixers (Unidur and Vacuum also), Gemco 2000 lbs. 56 cu. ft. Double Cone Blender, Mikro Bantam, 15H, 1P, 2TH Pulverizers, Day, Rotox, Tyler Hum-mer, Robinson, Raymond, Gayco, Great Western Sifters, Colton 2RP and 3RP Rotary Tablet Machines, Carver Laboratory 20 ton hydraulic Press, Package Machy, FA, FA2, FA4, Miller, Hayssen, Wrap-King, Scandia, Hudson Sharp, Oliver Auto, Wrappers—all sizes. This is only a partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements.

UNION STANDARD EQUIPMENT CO.  
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FOR SALE: High impact styrene sheet haul-off package, includes 48" adjustable lip die and control, haul-off rolls, pull rolls and trimming knives like new, \$7600. Latest type #2 1/2 and 3 1/2" extruder, long X alloy lined barrel variable drive and motor, heat regulation control, several screws, 36" sheeting die, Lay flat Polyethylene film take-up equipment & die. Reply Box 4033, Modern Plastics.

FOR SALE: Injection Presses: 4, 8, 12, 24 oz. Reeds, 2, 9, 60 oz. HPM, 32 oz. Vertical HPM, 1, 2 oz. Van Dorn, 4 oz. Lewis, 8, 12, 20 oz. Leominster, 12, 48 oz. Watson, Extruder: Stokes-Windsor HC 65 Twin Screw, Cumberland O & 1 Granulator, 7" Stair-Step Dicing Mach.—Ovens—Temper, Circulators, 48" Stokes Vac. Metalliz. Setup—6"x12" Lab. Mill—Compression Presses 50 to 600 tons, 15 T. Stokes Automatics, Stokes No. 294 & Kux No. 60 Preform presses, 30 HP Oil boiler, Auto-Vac 52"x30" Vac. Form. Mach. 200 T. Hobbing Press, 24 & 16 Carrier Braiding Mach. All Midwest locations. List your Surplus Equipment with me. JUSTIN ZENNER, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: Stainless Steel Rotary Dryer, Link Belt Co., 52"x16", No. 502-16, with all auxiliary equipment. Roto leave also 6"x24" and 8"x26". Hersey Stainless Steel Rotary Driers. Reply Box 4080, Modern Plastics.

HYDRAULIC PRESSES: Baldwin-Southwark 3600 Ton Belt Press, Elmes 1900 Ton Hobbing Press, MD Pump, HPM 750 Ton, Down-acting, Self-contained, Watson-Stillman 600 Ton Hobbing Press, MD Pump, Elmes 350 Ton, Down-acting, Self-contained, Lake Erie 215 Ton, Self-contained, Semi-automatic, Farquhar 100 Ton, Down-acting, Self-contained, Watson-Stillman 100 Ton, Burroughs 75 Ton Electrically Heated, HPM 35 Ton Molding Presses, Watson-Stillman and Elmes 30 Ton and 20 Ton Lab Presses, Stokes Model 200-D2 Automatic and Stokes 150 and 100 Ton Semi-automatic Presses. INJECTION MACHINES: Impro Model VF-822A, 22 Oz. De Mattia Model B, 24 Oz. HPM Model 250-H-16, 16 Oz. HPM Model 200-H-9, 9 Oz. Reed-Prentice, 13 Oz., 1952 Machine, Watson-Stillman 2 Oz. Van Dorn Model H-200, 1 Oz. (2). TABLET MACHINES: Stokes 8-5, R. T. RDS-3; Colton #5, #5 1/2, 2-RP and 3-RP. MILLS: 4—Farrel 16" x 40"; 4—Farrel 18" x 50". Available as Mill Lines or as individual Units. EXTRUDERS: Royle Nos. 1, 2, 3 and 4, Allen 6"—All Individual Motor Drive, MIXERS: Banbury #1, Chrome Plated Interior, 50 HP Motor Drive, Oil Heating System, Baker-Perkins 2 1/2 Gallon, Jacketed, Gearmotor Drive, MISCELLANEOUS: Vulcanizers, Calenders, Scrap Cutters, Pumps, Valves, Platens, Etc. JOHNSON MACHINERY COMPANY, 683-P Frelinghuysen Avenue, New York 5, New Jersey. Bigelow 5-2500. WHAT HAVE YOU FOR SALE? WHAT ARE YOU LOOKING FOR?

FOR SALE: Heavy Duty Double Arm Sigma Blade Mixers, (4) Reeds 50 gal, 30 HP; (2) W & F 100 gal; (1) Day 30 gal. (2) Kux Rotary Pellet Presses, (4) Sprout-Waldron Horizontal Ribbon Mixers 336 cu. ft. (12,000 #) capacity, (1) 1300 gal. T316 St. Kettle, jacketed 25 # atmospheric internal paddle agitator, (1) St. St. Pug Mill 7" dia. x 3 3/4" long overlapping chambers, jacketed 75 #, Mikro Pulverizers #2DH, #2TH, (3) Fitzpatrick St. St. Comminuting Machines, Models D, K & F, (3) Patterson Kelley Twin Shell Blenders, St. St. 5 cu. ft. and 10 cu. ft. We buy your surplus equipment. PERRY EQUIPMENT CORP., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: One 3 H.P. and four 2 H.P. Mears-Kane High Pressure Boilers, six But-tonex machines, one Stainless and one Copper Coating Pan, one Bee Gee Hammer Mill, MOLDED PLASTIC BUTTON CORP., 829 Newark Ave., Elizabeth, N. J. Tel: Elizabeth 4-5585.

## MACHINERY and EQUIPMENT WANTED

WANTED: Compression Molding Presses, all types. Reply Box 4001, Modern Plastics.

WANTED: Cameron type slitter with double take-off, 40 to 50" wide. Must rewind to 18" diameter. Reply Box 4051, Modern Plastics.

WANTED: Used 2-Roll Mill for laboratory suitable for plastics. Reply PLASTIC INDUSTRIAL PRODUCTS, INC., 363 Highland Ave., Somerville 44, Mass.

WANTED: Resin Kettles, stainless steel or glass lined, from pilot plant up to 2000 gal. sizes. Also Rotary Pellet Presses; B & J cutters; Mikro Pulverizers; etc. Send us your list of surplus equipment. PERRY EQUIPMENT CORP., 1429 N. 6th St., Phila. 22, Pa.

WANTED: Plastic manufacturer needs 50 ton hydraulic Stokes, #741 press. Give full details on age of machine, condition and cost. Reply Box 4023, Modern Plastics.

(Continued on page 258)

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## CLASSIFIED ADVERTISING

(Continued from page 256)

### WANTED TO PURCHASE

Extruders: 2 1/2", 3 1/2", 4 1/2". Material grinder: Ball and Jewell or Cumberland, 18" blades. Reply Box 4011, Modern Plastics.

WANTED: 1 used plastic scrap grinder 8" to 12"x24" throat opening. State condition, size, make, serial number, and price. Reply Box 4047, Modern Plastics.

VACUUM COATING MACHINE WANTED: We are in the market for a vacuum coating unit with a four foot tank or larger. Give make, age and asking price in your reply. TRIANGLE MFG. COMPANY, 134 Water Street, Leominster, Mass.

WANTED: Extrusion machine 2 1/2" together with accessory equipment or small extrusion plant. Laminating press, multiple opening, 12"x14" to 24"x30", electrically heated platens preferred. FOR SALE: Cumberland Model 0 Granulator A-1 condition, complete with electrical equipment. Reply Box 4049, Modern Plastics.

## MATERIALS FOR SALE

FOR SALE: 10,000 lbs. Bright Blue Virgin Tenite 1; 7,000 lbs. Transparent Pink Tinsel Virgin Cellulose Acetate; 7,000 lbs. White Virgin High Impact Polystyrene; 4,000 lbs. Standard Baby Blue Virgin High Impact Polystyrene; 10,000 lbs. Yellow Reprocessed High Impact Polystyrene; 8,000 lbs. Green and Blue Reprocessed High Impact Polystyrene; 5,000 lbs. Red Reprocessed High Impact Polystyrene; 24,000 lbs. Reground light Standard Colors High Impact Polystyrene; 10,000 lbs. each, Red, Green, Yellow Reprocessed Polystyrene; 10,000 lbs. Natural and Colors Reground C-11; 30,000 lbs. Black Reprocessed Polyethylene; 50,000 lbs. Transparent Red Methyl Methacrylate Tailight formulation. Samples and prices on request.

A. BAMBERGER CORPORATION  
703 Bedford Ave., Brooklyn 6, N. Y.  
Telephone—Main 5-7450

PLASTICIZERS: 20,000 lbs. DIOP prime quality in drums, very low price. Also Dibutyl, Dicapryl, Dimethyl Phthalates. Let us know your requirements. CHEMICAL AFFILIATES, INC., 274 Madison Ave., New York 10, N. Y. Tel: MU 3-4731.

## MATERIALS WANTED

### WANTED

Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.

A. BAMBERGER CORPORATION  
703 Bedford Ave., Brooklyn 6, N. Y.  
Main 5-7450

SCRAP PLASTICS: All forms, waste and surplus plastic molding materials, rejects in any form. We will also buy your obsolete inventories of molding powders, stabilizers, plasticizers and other plastic and chemical materials. ACETO CHEMICAL CO., INC., 40-46A Lawrence St., Flushing 54, N. Y. Independence 1-4100.

WANTED: Polystyrene: virgin, off color, clean reground, or reprocessed, all colors. End users. STERLING PLASTICS CO., 1140 Commerce Ave., Union, New Jersey.

WANTED: PLASTIC SCRAP. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. GEORGE WOLOCH, INC., 601 West 26th Street, New York 1, N. Y.

PLASTIC SCRAP: Polystyrene, Hi Impact Polystyrene, Polyethylene and Acetate. TOP PRICES PAID. PLASTIC MOLDING POWDERS, INC., 2004 McDonald Ave., B'dym 23, N. Y. ES 5-7943.

WANTED: Plexiglas and Lucite scrap, salvage and cut-offs, any quantity. Turn your surplus sheet stock into cash. Ask for our quotation. DUKE PLASTICS CORP., 584 Broadway, Bklyn 6, N. Y. Evergreen 8-5520.

WANT TO CONTACT injection molder with stock molds to manufacture for us knobs for TV and radio sets. This will be a long-term contact with plenty of continual repeat business. ARROW MFG. DIV'N, Box 6801, Amarillo, Texas.

PLASTIC SCRAP WANTED: All types and grades, any quantity. Write or telephone. SUCCESS PLASTICS RECOVERY WORKS, INC., Post Office Box 566, Indianapolis 6, Ind. Phone Liberty 4-2919.

## MOLDS FOR SALE

### FOR SALE

Beautiful Sewing Cabinet Molds for 8 oz. molding machine. For particulars, Reply Box 4020, Modern Plastics.

RELIGIOUS ARTICLE: In constant demand, fast moving, Sick Call Set, a must with every Catholic outlet. 13 1/2" long, consisting of 4 molds, one top-cross, one bottom, one Corpus or Christ figure and one top emblem. In perfect condition, very fast injection mold cycle for 8-ounce machine. Original cost \$12,000.00, will sacrifice due to retirement from business. Reply Box 4038, Modern Plastics.

INJECTION MOLDS: One 6-cavity (3 units) and one 12-cavity (6 units) plastic hinged Soap-Box; one 8-cavity (4 units) Cigarette Case to hold 26-regular size Cigarettes; 2 Poker Chip Molds; one beautifully designed utility box, one 8-cavity bath-room tile mold and several others. All will fit the 8-ounce Reed-Prentice or any make injection machine. All are almost new, in guaranteed perfect working condition. Reasonable prices—immediate possession. Reply Box 4032, Modern Plastics.

TELEVISION TURN-TABLE: 12" Diameter, 1 Mold for compression molding, mold recently completed and never marketed. Original cost \$4,000.00. Will sacrifice. Reply Box 4040, Modern Plastics.

INJECTION MOLDS: Excellent opportunity to enter TV supply field with injection molds for producing polyethylene insulators. 5 molds available, from 8 to 39 cavity, all in excellent condition. Two brand new. To purchase today would cost \$17,000.00—will sacrifice at very reasonable price. Further information on request. Reply Box 4021, Modern Plastics.

FOR SALE: One Injection Mold to Make Neat Plastic Recipe Box with interesting Trim. Also—One Mold for Plastic Watering Can for House Plants in Attractive 2 Tone Colors and Style. \$975.00 each FOB Chicago. Worth many times this amount. DOT'S STOCKING DRYER CO., 2500 Griffith Park Blvd., Los Angeles, Calif. Phone Normandy 11954.

MODERN 3"x5" INDEX OR RECIPE BOX—Terrific stationery and premium trade item, standard size, holds 300 cards. 2 perfect molds, 6 covers, 6 bottoms, very fast cycle and assembly for compression molding, can be altered for injection. Original Cost \$11,000.00, will sacrifice. Reply Box 4039, Modern Plastics.

## HELP WANTED

REGIONAL SALES MANAGER: AAA-1 manufacturer structural reinforced plastics and translucent building panels sell industrials and distributors Chicago area and supervise for mid-west territories. Salary and commission. Write complete details to Box 4048, Modern Plastics.

### WANTED

One Supervisor and one M.E. for Plastic and Adhesive Division of nationally known company, California Branch, with several years experience in adhesives and isocyanate foams, or related fields. Capable of scheduling production and working closely with Sales and Engineering in production. State full particulars including experience, age, marital status, salary required, availability, and a recent photo. Excellent opportunity for two good men. Reply Box 4044, Modern Plastics.

SALESMAN: A challenge to a salesman with ideas and imagination. Established plastic manufacturer of electronic parts in Philadelphia area wants to expand in new field or products. An opportunity for the man who can develop the right market. Send full resume and state expected salary. Reply Box 4029, Modern Plastics.

### CHEMISTS AND CHEMICAL ENGINEERS

For product development in plastics field. Outstanding opportunity to join recently formed Product Development Department of the ATLAS POWDER COMPANY, located in Wilmington, Delaware. 5-10 years experience in polymers and their application areas required. Direct all replies to: R. L. Herrman, Atlas Powder Company, Wilmington, Delaware, marked personal. All responses held confidential.

MOLD MAKERS, Designers, and Draftsmen. Product design experience desirable. Excellent opportunity to grow with progressive company. CACO, INC., Pomona, California.

### PLASTICS SALES ENGINEER

Large established and well respected Chicago Injection Molding, Finishing and Extrusion Company seeks experienced man with industrial and packaging experience. Salary plus commission. Will be given active territorial accounts. All replies strictly confidential.

### SUPERIOR PLASTICS, INC.

426 No. Oakley Blvd., Chicago 12, Illinois

PLASTIC ENGINEER: Chicago Company not now in plastics requires project man for product and process development in vacuum forming of plastics. Must be skillful experimenter, experienced in the field, with ability to carry projects into production. Complete employee benefits, excellent advancement opportunities. Send resume and salary requirements to Box 4046, Modern Plastics.

### EXTRUSION SUPERVISOR

Thoroughly familiar with die design, set up, and running intricate shapes wanted by leading Eastern custom-extrusion house. Congenial working conditions. Company will help relocate right man. Enquiries will be treated in utmost confidence. Reply President, Box 4007, Modern Plastics.

(Continued on page 260)

Modern Plastics

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Mr. Charles R. Eastman  
Personnel Manager  
KORDITE COMPANY  
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## CLASSIFIED ADVERTISING

(Continued from page 258)

**GROUP LEADER:** Organic chemist with 5-20 years experience in plastics, vinyl stabilizers and related compounds. To head new group in a growing, progressive organization. Pleasant working conditions in a new air-conditioned laboratory. Midwest location. Fringe benefits. Send resume including photo and salary desired. Reply Box 4913, Modern Plastics.

**VINYL CHEMIST**  
Manufacturer calendered film and vinyl sheeting requires experienced chemical engineer or chemist. All replies confidential. Reply Box 4903, Modern Plastics.

**CHEMIST:** Experienced in the production of Acrylic and Polyester sheets for Imitation Pearl Buttons. Reply Box 4922, Modern Plastics.

**PRODUCT SALES**  
We are seeking a Mechanical Engineer who is interested in Product Development and Technical Sales as a career and is experienced in plastic molding or extrusion equipment. We are an expanding producer of a complete line of compression, injection and extrusion equipment and have been established for over 50 years. This position offers opportunities for advancement into technical management. Occasional travel will be required. Kindly give your education, experience and salary requirements in your resume. All replies will be held confidential. Write: F. J. STOKES MACHINE COMPANY, 5500 Tabor Road, Philadelphia, Penna.

**HELP WANTED—ENGINEER:** Chemist or mechanical engineer experienced in Slush Molding Vinyls to take charge of department for Los Angeles Mfr. Excellent opportunity. Salary open. Give Details. Reply Box 4925, Modern Plastics.

**FLOOR TILE CHEMIST**  
Experienced manufacture vinyl tile. Location, Midwest. Liberal insurance and pension plan. Reply Box 4904, Modern Plastics.

**ORGANIC RESEARCH CHEMIST** for research and development of phenolic resins. Experience with phenolic and other types of resins desirable. The position is permanent and offers an excellent opportunity for advancement with an established company located in the East. In reply please give age, experience, education and salary requirements. Reply Box 4926, Modern Plastics.

**PLANT MANAGER**  
We seek an experienced factory executive to take full charge of manufacturing quality control, personnel, and maintenance. Engineering degree and experience are essential and knowledge of polyethylene film extrusion is desirable. The desired person will supervise 100 employees and report directly to the president. Location Metropolitan New York. Send complete resume and salary requirement. Reply Box 4937, Modern Plastics.

**TECHNICAL SALES/SERVICE:** Excellent opportunity for technical graduate interested in sales-service, who has two or more years experience with vinyl application. Opening is in rapidly expanding division of an established Midwest Chemical Manufacturer. Please send resume including salary requirements. Reply Box 4931, Modern Plastics.

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Man experienced in color matching and production color control in film and sheeting. Reply Box 4905, Modern Plastics.

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**MOLDING ROOM SUPERINTENDENT:** With Heavy Experience in Compression Molding. Write Giving Details Experience and Salary Requirements to OLYMPIC PLASTICS CO., INC., 3471 S. LaCienega Blvd., Los Angeles 16, Calif.

**CHEMICAL ENGINEER**  
Outstanding opening with energetic, progressive organization in Northern New Jersey for a man with 2-5 years experience in application research in field of processing, compounding and formulating of polyvinyl chloride, rubber, etc. Experience in calendered plastics, either film or sheeting preferred. Familiarity with pilot plant and manufacturing operations essential. Write with full particulars including salary required. Reply Box 4945, Modern Plastics.

**HELP WANTED:** Maintenance engineer for plastic calenders, mills, banbury. Must be experienced. Reply Box 4959, Modern Plastics.

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**MANUFACTURERS' REPRESENTATIVES** now calling on injection molders wanted by Eastern manufacturer of top quality regular and impact polystyrenes. Commission basis. Many territories open. Reply stating territory covered, lines now carried, experience. Reply Box 4906, Modern Plastics.

**MANUFACTURERS' REPRESENTATIVES:** Now calling on Plastics and Textile Industry. Wanted by Vacuum Forming Machine, Industrial radiant panel and ceramic block heater manufacturer. Commission basis. We are receiving many inquiries from all over the country that need personal follow up. Reply giving experience and territory to Box 4915, Modern Plastics.

**NEW YORK MOLDER** with Injection Capacity up to 60 oz., own Machine Shop, desires representative for Metropolitan New York, Upper New York State, Philadelphia and Pennsylvania areas, New England. Full territorial protection given. Commission 5%. Write, Robert D. Ordo, RONA PLASTIC CORP., 1325 Blondell Ave., New York 61, N. Y.

**MANUFACTURERS** of vacuum forming, custom fabrications require representatives now calling with plastic lines on end users. Can offer vacuum, drape, press, snap back and blow forming. Plenty of experience in solving tough fabricating problems. Commission basis. Reply: territories, background, contacts covered, items carried. ATLAS VACUUM CORP., 367 Orchard Street, Rochester, New York.

**EXCLUSIVE REPRESENTATION**  
Established West Coast plastic firm now selling molding powders, plastic sheet and plastic pipe seeks exclusive representation for manufacture of an additional related line. Reply Box 4917, Modern Plastics.

**DISTRIBUTORS or Sales Representatives** wanted by East Coast Manufacturer of Electronic Heat Sealing machinery. Products advertised nationally. Excellent potential. Send full data with background and experience, territory covered, and present lines handled. Also seeking salesmen to work out of New York office in Metropolitan area. Reply Box 4902, Modern Plastics.

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**MANUFACTURERS REPRESENTATIVE or Sales Agent** wanted for St. Louis and Chicago areas by custom plastic molder located in Midwest. Straight commission basis. Modern plant and complete facilities for handling all types of plastics. Reply Box 4918, Modern Plastics.

(Continued on page 261)

## CLASSIFIED ADVERTISING

(Continued from page 260)

**SALES AGENTS WANTED:** To handle highly competitive line of extruded plastics, vinyl, polyethylene, tubing, welding, special shapes. Many territories open, especially New England, N. Y., Philadelphia, Chicago. Reply MR. BEE, 3577 Kenmore Rd., Shaker Heights 22, Ohio.

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**REPRESENTATION BALTIMORE AND VICINITY:** Foremost supplier of metallized acetate, polystyrene, butyrate and Mylar sheeting seeks aggressive representation to contact vacuum formers, laminators, point-of-purchase display houses and other users of metallized sheeting. Reply Box 4052, Modern Plastics.

## MISCELLANEOUS

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**INDUSTRIAL ORGANIZER** and Plastic Manufacturer (heat sealing, laminating and vacuum forming) is looking for an agent-representative in the United States who would carry out commissions for us. We offer the same for Argentina. Please write for details to ARCO PLAST, PARAGUAY 1346, 1-er Piso, Buenos Aires.

**TWO U.S. TRAINED P.H.D.s** starting consulting firm in Mexico City soon. Fluent spoken and written Spanish, 8 years experience with top U. S. companies specializing in acrylic, polyester, phenolic, vinyls and rubber manufacture and fabrication and electroplating and metal finishing. Would like to hear from reliable companies wanting either process installation or technical sales and service representation in Mexico. Reply Box 4030, Modern Plastics.

**ATTENTION—Export to Germany:** German, dynamic, reliable, age 48, desires to represent American manufacturer. Has 7 years business experience Far East, many years manager and owner textile plant Soviet zone (expropriated). University graduate (Dr. economics), speaking German, English, French. Resident Rhineland. First class references. Reply Box 4014, Modern Plastics.

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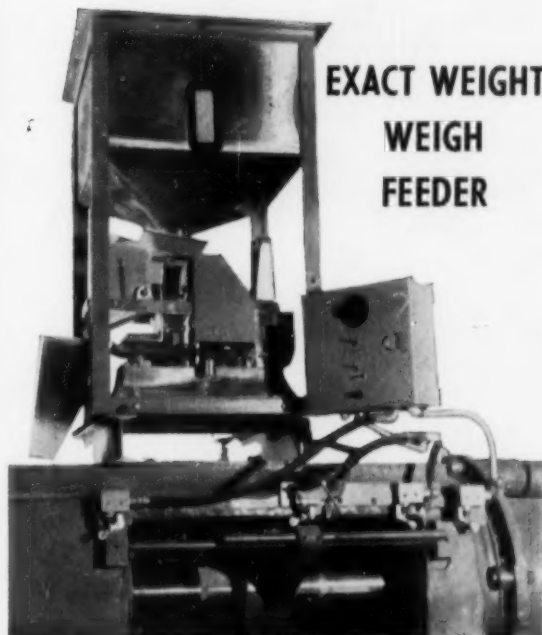
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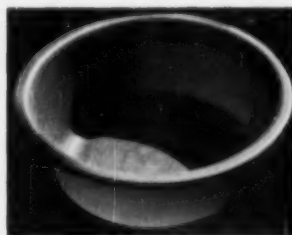
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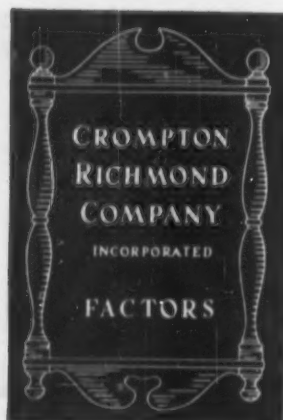
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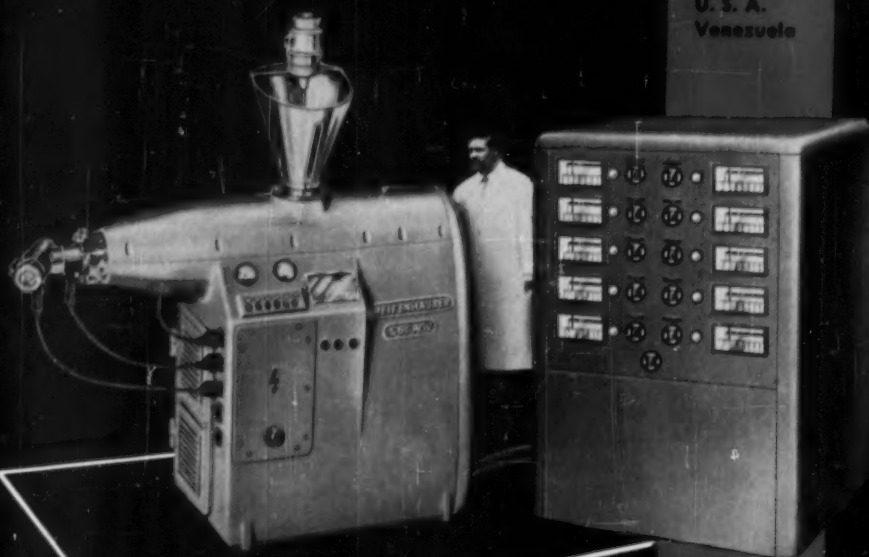
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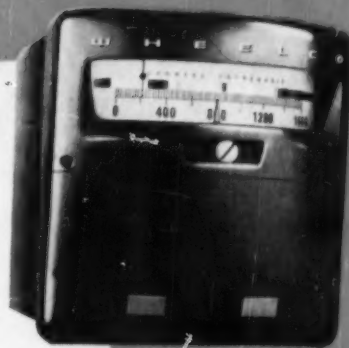
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PX-800 Epoxy  
PX-917 TriCresyl Phosphate



# "FAST CURE... even with heavy sections"

...through G.E.'s new  
12900 Black  
general-purpose  
phenolic molding compound



That's what Wheelco Instruments Division\* reports! Wheelco uses General Electric 12900 Black to mold covers for Series 400 Capacitrols. Besides fast cure, Wheelco benefits by the way G-E 12900 provides a good-looking, high-gloss finish!

\*Warner-Columbus Company, Rockford, Ill.

General Electric's new 12900 Black and 12901 Brown are among the fastest-curing and most versatile phenolic materials on the market today. Suitable for cold powder as well as preheat applications, these high-density powders result in uniform pill weight, fast cures, and rigid set. Where can you use them to increase output, lower production costs and mold high-quality, attractive plastic parts?

For more information  
on G-E general-purpose  
molding compounds,  
just write to General  
Electric Company,  
Section 1521-6A, Chemical  
Materials Department,  
Pittsfield, Mass.

*Progress Is Our Most Important Product*

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